As the market leader in North America, the Gibraltar Cable Barrier System is the best designed, easiest-to-install system, making it safer and a better value for highway contractors and maintenance crews.

Gibraltar Cable Barriers . . . *Simply Better*

MASH 2016
TL4 CABLE BARRIER SYSTEM

Gibraltar Cable Barrier System
1208 Houston Clinton Dr.
Burnet, Texas 78611
+1 (512) 715-0808
www.gibraltarglobal.com

Updated: March 2024

TABLE OF CONTENTS

(Click heading to go to location)

Return to Table of Contents

Testing Summary

TL4 Flat Terrain

Eligibility Letter	Test No.	Test Vehicle	Nominal Speed (mph)	Nominal Angle (deg)	Post Spacing	Working Width/ Deflection	
B-316	4-10	1100C	62	25	7.0	7.6	Flat Terrain
B-316	4-11	2270P	62	25	7.0	7.9	Flat Terrain
B-316	4-11	2270P	62	25	21.0	13.8	Flat Terrain
B-316	4-12	10000S	55	15	21.0	17.4	Flat Terrain

4:1 or Flatter

Eligibility Letter	Test No.	Test Vehicle	Nominal Speed (mph)	Nominal Angle (deg)	Post Spacing	Working Width/ Deflection	
B-340	3-13	2270P	62	25	7.0	12.5	4:1[A,B]
B-340	3-14	1100C	62	25	7.0	5.5	4:1[A,B]
B-340	3-17	1500A	62	25	18.0	13.5	4:1[A,C]
B-340	3-16	1100C	62	25	7.0	3.0	4:1[A,D]
B-340	3-18	2270P	62	25	16.0	15.0	4:1[A,E]

TL3 Terminal

Eligibility Letter	Test No.	Test Vehicle	Nominal Speed (mph)	Nominal Angle (deg)	Post Spacing	Working Width/ Deflection	
CC-162	3-30	1100	62	0	N/A	N/A	Flat Terrain
CC-162	3-31	2270P	62	0	N/A	N/A	Flat Terrain
CC-162	3-32	1100C	62	5	N/A	N/A	Flat Terrain
CC-162	3-33	2270P	62	5	N/A	N/A	Flat Terrain
CC-162	3-34	1100C	62	15	N/A	N/A	Flat Terrain
CC-162	3-35	2270P	62	25	N/A	N/A	Flat Terrain
CC-162	3-37b	2270P	62	25	N/A	N/A	Flat Terrain

A. For systems placed on 4:1 slopes, the system shall be placed no farther than 4.0ft down the Front SBP, and no closer than 15.0' from the ditch bottom

B. 4.0ft from the Front SBP on 46.0ft Wide V-ditch

C. 2.0ft from the Front SBP on 46.0ft Wide V-ditch

D. 4.0ft from the Back SBP on 46.0ft Wide V-Ditch

E. 8.0ft from the Back SBP on 46.0ft Wide V-ditch(15' from ditch bottom)

Return to Table of Contents

U.S. Department of Transportation
Federal Highway Administration

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

June 19, 2020

In Reply Refer To:
HSST-1/B-316A

Mr. Ron Faulkenberry
Gibraltar Global LLC
1208 Houston Clinton Drive
Burnet, TX 78611
United States

Dear Mr. Faulkenberry:

On February 27, 2020, The Federal Highway Administration's Office of Safety issued eligibility letter B-316 for the Gibraltar Global TL-4 Cable Barrier System. The Office of Safety has recently made modifications to its eligibility letter website to be more consistent with the 2nd Edition of American Association of State Highway and Transportation Officials'(AASHTO's) Manual for Assessing Safety Hardware (MASH) and the additional test matrices for cable barriers therein. These modifications have necessitated the update of certain eligibility letters including B-316. The modification for B-316 consists of adding the phrase "Level Terrain" after the original description of the device to indicate the as-tested conditions.

Please note that this updated letter B-316A will in no way affect the eligibility for the associated device as was determined on February 27, 2020. This letter will supersede the original letter B-316 in full.

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-4 Cable Barrier System, Level Terrain

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-4 Cable Barrier System, Level Terrain
Type of system: Longitudinal Barrier
Test Level: MASH Test Level 4 (TL4)
Testing conducted by: KARCO Engineering
Date of request: November 02, 2018

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-316A 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. Griffith

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

Enclosures

Return to Table of Contents

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	November 02, 2018	(•) New ( ) Resubmission
	Name:	Robert Ramirez	
	Company:	KARCO Engineering	
	Address:	9270 Holly Rd. Adelanto, CA 92301	
	Country:	United States	
	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 Criterion - Enter from right to left starting with Test Level

!-!-!

System Type	Submission Type	Device Name / Variant	Testing Criterion	Test Level
'B': Rigid/Semi-Rigid Barriers (Roadside, Median, Bridge Railings)	(•) Physical Crash Testing ( ) Engineering Analysis	Gibraltar Global TL-4 Cable Barrier System	AASHTO MASH	TL4

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 as Submitter ☐
Company Name:	Gibraltar Global LLC	Same as Submitter ☐
Address:	1208 Houston Clinton Drive, Burnet, TX 78611	Same as Submitter ☐
Country:	United States	Same as Submitter ☐

Enter below all disclosures of financial interests as required by the FHWA `Federal-Aid Reimbursement Eligibility Process for Safety Hardware Devices' document.

All MASH testing was conducted at Karco Engineering in Adelanto, CA. Karco Engineering was compensated for conducting the tests but has no financial nor patent interests in any of Gibraltar's products.

PRODUCT DESCRIPTION

(•) New Hardware or Significant Modification   ( ) Modification to Existing Hardware

The Gibraltar Global TL-4 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 pins and steel lock plates. The C-section posts were placed on alternate sides of the 4 cables and are held in place by the aluminum hair pins. The top two (2) cables of the system were stitched together making the cables alternate in the top hairpin location. The hair pins held the cables at 20.0 in (508 mm), 30.0 in (762 mm) and 39.0 in. (991 mm) above grade. The system can be installed with post spacing ranging from 7 ft. to 21 ft.

Gibraltar also offers various post and socket options such 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.

CRASH TESTING

By signature below, the Engineer affiliated with the testing laboratory, agrees in support of this submission that all of the critical and relevant crash tests for this device listed above were conducted to meet the MASH test criteria. The Engineer has determined that no other crash tests are necessary to determine the device meets the MASH criteria.

Engineer Name:	Robert Ramirez	
Engineer Signature:	Robert Ramirez	Digitally signed by Robert Ramirez DN: cn=Robert Ramirez, o=KARCO Engineering, ou=Project Engineer, email=rramirez@karco.com, c=US Date: 2018.11.01 15:54:48 -07'00'
Address:	9270 Holly Rd. Adelanto, CA 92301	Same as Submitter ☐
Country:	United States	Same as Submitter ☐

A brief description of each crash test and its result:

Required Test Number	Narrative Description	Evaluation Results
4-10 (1100C)	KARCO Engineering Project number P37379-01 was conducted with an 1100C test vehicle impacting the system midspan between posts at 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 Kia Rio weighing 2,427.2 lbs (1,101.0 kg) impacted the system at a speed 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

Required Test Number	Narrative Description	Evaluation Results
4-11 (2270P)	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. KARCO Engineering 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 a speed and angle of 60.93 mph (98.06 km/h) and 25.3 degrees, 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. KARCO Engineering 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 a speed 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.	PASS

4-12 (10000S)	KARCO Engineering Project number P37320-01 was conducted with an 10000S test vehicle impacting the system 1.0 ft. (0.3 m) upstream of a post at a nominal velocity and angle of 56 mph and 15 degrees, respectively. The largest allowable post spacing of 21.0 ft. (6.4 m) was tested to increase the loading on the splices. The test vehicle, a 2007 Ford F650 weighing 22,641.1 lbs (10,270.0 kg) impacted the system at a speed and angle of 54.39 mph (87.54 km/h) and 14.9 degrees, respectively. The system redirected the vehicle and had a maximum working width of 17.4 ft. (5.3 m). The maximum test debris was approximately 25 ft. laterally to the non-traffic side of the barrier. 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.	PASS
4-20 (1100C)	Test 4-20 is not applicable for this type of system.	Non-Relevant Test, not conducted
4-21 (2270P)	Test 4-21 is not applicable for this type of system.	Non-Relevant Test, not conducted
4-22 (10000S)	Test 4-22 is not applicable for this type of system.	Non-Relevant Test, not conducted

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:	Applus IDIADA KARCO Engineering	
Laboratory Signature:	AB	Digitally signed by Alex Beltran DN: cn=Alex Beltran, o=KARCO Engineering, ou=Testing Laboratory, email=abeltran@karco.com, c=US Date: 2018.11.01 15:51:22 -07'00'
Address:	9270 Holly Rd. Adelanto CA. 92301	Same as Submitter ☐
Country:	United States	Same as Submitter ☐
Accreditation Certificate Number and Dates of current Accreditation period :	TL-371 valid up to July 1, 2019	

Submitter Signature*: Robert Ramirez

Digitally signed by Robert Ramirez
DN: cn=Robert Ramirez, o=KARCO Engineering, ou=Project Engineer, email=rramirez@karco.com, c=US
Date: 2018.11.02 08:22:48 -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

Return to Table of Contents

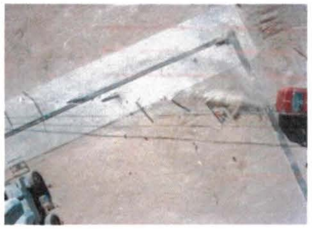
MASH Test 4-10 Summary

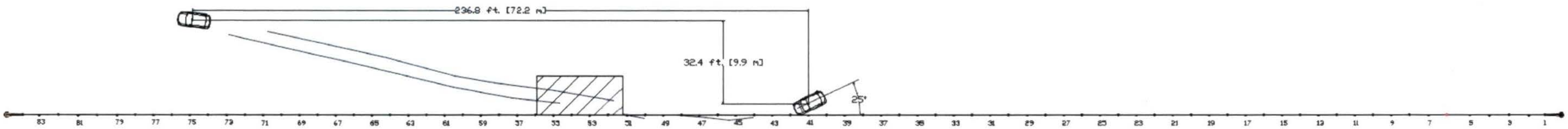

0.000 s


0.200 s


0.400 s


0.600 s


0.800 s



GENERAL INFORMATION	
Test Agency	KARCO Engineering, LLC.
KARCO Test No.	P3791-01
Test Designation	4-10
Test Date	12/06/17
TEST ARTICLE	
Name / Model	TL-4 Cable Barrier System
Type	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 lbs (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)

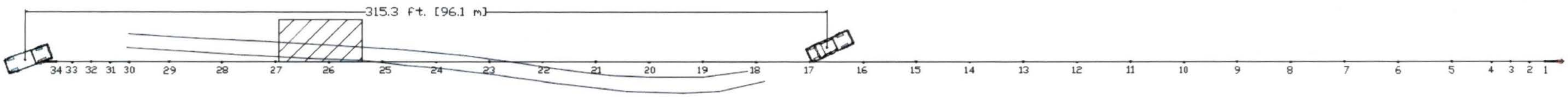
Impact Conditions	
Impact Velocity	62.38 mph (100.39 km/h)
Impact Angle	25.1°
Location / Orientation	3.5 ft. (1.1 m) upstream of Post 42
Impact Severity	56.8 kip-ft (77.0 kJ)
Exit Conditions	
Exit Velocity	50.2 mph (80.8 km/h)
Exit Angle	7.1°
Final Vehicle Position	236.8 ft. (72.2 m) Downstream 32.4 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 Angle	8.3°
Maximum Yaw Angle	-30.0°

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
Vehicle Damage	
Vehicle Damage Scale	11LFQ6
CDC	11LYAK8
Maximum Intrusion	1.0 in. (25 mm)

Figure 3 Summary of Test 4-10

MASH Test 4-11 Summary

0.000 s | 0.200 s | 0.400 s | 0.600 s | 0.800 s



GENERAL INFORMATION	
Test Agency	Applus IDIADA KARCO
KARCO Test No.	P37359-01
Test Designation	4-11
Test Date	12/07/18
TEST ARTICLE	
Name / Model	TL-4 Cable Barrier System
Type	Longitudinal Barrier
Installation Length	597.7 ft. (182.2 m)
Post Spacing	21.0 ft. (6.4 m)
Key Elements	Cable, Hair Pins, Lock Plates
Road Surface	Concrete and Soil
TEST VEHICLE	
Type / Designation	2270P
Year, Make, and Model	2013 Chevrolet Silverado 1500
Curb Mass	5,067.2 lbs (2,298.5 kg)
Test Inertial Mass	5,028.7 lbs (2,281.0 kg)
Gross Static Mass	5,028.7 lbs (2,281.0 kg)

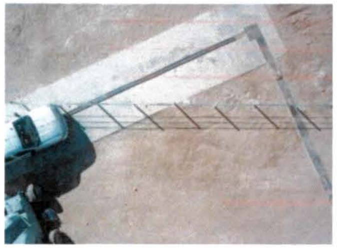
Impact Conditions	
Impact Velocity	61.78 mph (99.43 km/h)
Impact Angle	25.1°
Location / Orientation	11.5 in. (292 mm) upstream from post 17
Impact Severity	115.5 kip-ft (156.5 kJ)
Exit Conditions	
Exit Velocity	47.40 mph (76.28 km/h)
Exit Angle	2.4°
Final Vehicle Position	315.3 ft. (96.1 m) Downstream 0.7 ft. (0.2 m) Traffic side
Exit Box Criteria Met	Yes
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Maximum Roll Angle	-3.1 °
Maximum Pitch Angle	-2.9 °
Maximum Yaw Angle	-25.7 °

Occupant Risk	
Longitudinal OIV	8.5 ft/s (2.6 m/s)
Lateral OIV	9.5 ft/s (2.9 m/s)
Longitudinal RA	-2.6 g
Lateral RA	3.4 g
THIV	13.1 ft/s (4.0 m/s)
PHD	3.7 g
ASI	0.31
Test Article Deflections	
Static	N/A
Dynamic	13.8 ft. (4.2 m)
Working Width	13.8 ft. (4.2 m)
Debris (lateral)	14.5 ft. (4.4 m)
Vehicle Damage*	
Vehicle Damage Scale	11-LFQ-3
CDC	11LFEN2
Maximum Intrusion	none

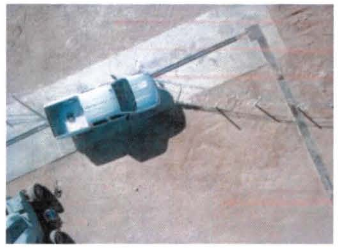
*Vehicle damaged assessed before secondary impact.

Figure 4 Summary of Test 4-11

MASH Test 4-11 Summary



0.000 s

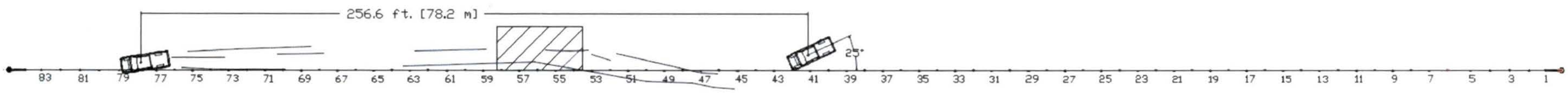


0.200 s

0.300 s

0.500 s

0.700 s



GENERAL INFORMATION	
Test Agency	Applus IDIADA KARCO
KARCO Test No.	P37358-01
Test Designation	4-11
Test Date	12/07/18
TEST ARTICLE	
Name / Model	TL-4 Cable Barrier System
Type	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
TEST VEHICLE	
Type / Designation	2270P
Year, Make, and Model	2013 Chevrolet Silverado 1500
Curb Mass	5,261.2 lbs (2,386.5 kg)
Test Inertial Mass	5,011.0 lbs (2,273.0 kg)
Gross Static Mass	5,011.0 lbs (2,273.0 kg)

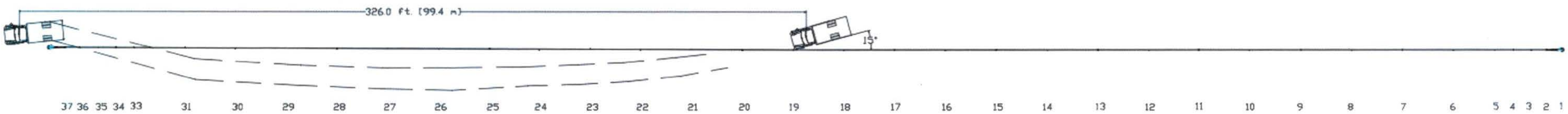
Impact Conditions	
Impact Velocity	60.93 mph (98.06 km/h)
Impact Angle	25.3°
Location / Orientation	1.5 in. upstream from Post 42
Impact Severity	113.6 kip-ft (154.0 kJ)
Exit Conditions	
Exit Velocity	36.7 mph (59.1 km/h)
Exit Angle	6.2°
Final Vehicle Position	256.6 ft. (78.2 m) Downstream 3.1 ft. (0.9 m) Right
Exit Box Criterion	Exited within exit box
Vehicle Snagging	None
Vehicle Pocketing	None
Maximum Roll Angle	5.4 °
Maximum Pitch Angle	3.6 °
Maximum Yaw Angle	-26.3 °

Occupant Risk	
Longitudinal OIV	9.2 ft/s (2.8 m/s)
Lateral OIV	12.1 ft/s (3.7 m/s)
Longitudinal RA	-4.0 g
Lateral RA	5.6 g
THIV	15.7 ft/s (4.8 m/s)
PHD	5.3 g
ASI	0.41
Test Article Deflections	
Static	0.5 ft. (0.2 m)
Dynamic	7.9 ft. (2.4 m)
Working Width	7.9 ft. (2.4 m)
Debris Field	10.0 ft. (3.0 m) Field side
Vehicle Damage	
Vehicle Damage Scale	11-LFQ-3
CDC	11LYEW2
Maximum Intrusion	0.5 in. (13 mm)

Figure 3 Summary of Test 4-11

MASH Test 4-12 Summary

0.000 s | 0.200 s | 0.400 s | 0.600 s | 0.800 s



GENERAL INFORMATION	
Test Agency	Applus IDIADA KARCO
KARCO Test No.	P37320-01
Test Designation	4-12
Test Date	12/5/17
TEST ARTICLE	
Name / Model	TL-4 Cable Barrier
Type	Longitudinal Barrier
Installation Length	625.7 ft. (190.7 m)
Key Elements	Cable, Hair Pins, Lock Plates
Road Surface	Concrete and Soil
TEST VEHICLE	
Type / Designation	10000S
Year, Make, and Model	2007 Ford F-750
Curb Mass	16,210.5 lbs (7,353.1 kg)
Test Inertial Mass	22,641.1 lbs (10,270.0 kg)
Gross Static Mass	22,641.1 lbs (10,270.0 kg)

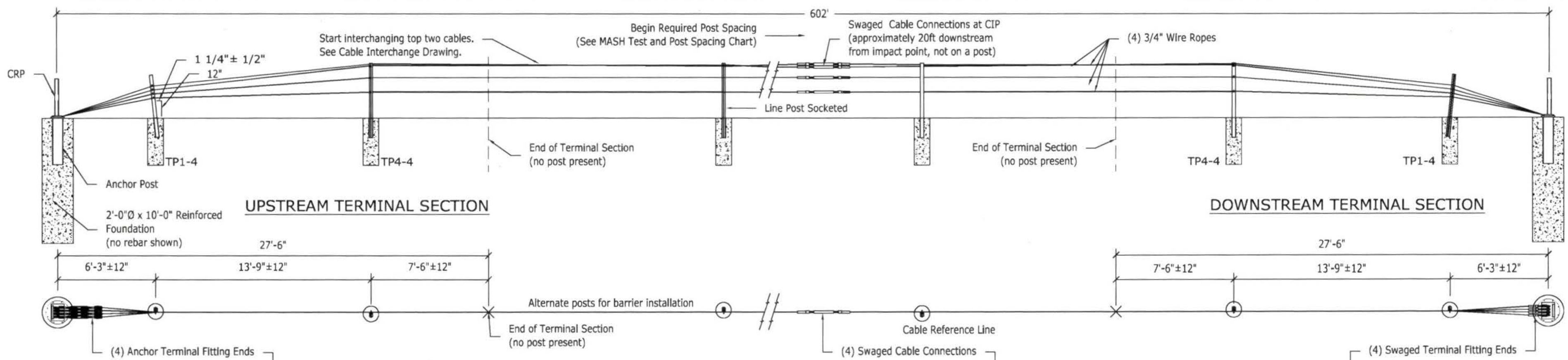
Impact Conditions	
Impact Velocity	54.39 mph (87.53 km/h)
Impact Angle	14.9°
Location / Orientation	1.0. ft. Upstream of Post
Impact Severity	148.0 kip-ft (200.7 kJ)
Exit Conditions	
Exit Velocity	N/A
Exit Angle	3.2°
Final Vehicle Position	326.0 ft. (99.4 m) downstream
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	None
Maximum Roll Angle	N/A
Maximum Pitch Angle	N/A
Maximum Yaw Angle	N/A

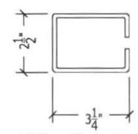
Occupant Risk	
Longitudinal OIV	N/A
Lateral OIV	N/A
Longitudinal RA	N/A
Lateral RA	N/A
THIV	N/A
PHD	N/A
ASI	N/A
Test Article Deflections	
Static	5.0 ft. (1.5 m)
Dynamic	N/A*
Working Width	17.4 ft. (5.3 m)
Vehicle Damage	
Vehicle Damage Scale	12-FL-2
CDC	12FLDW1
Maximum Intrusion	No measureable deformation

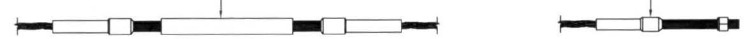
*Cable wrapped around vehicle. Measurement unable to be taken.

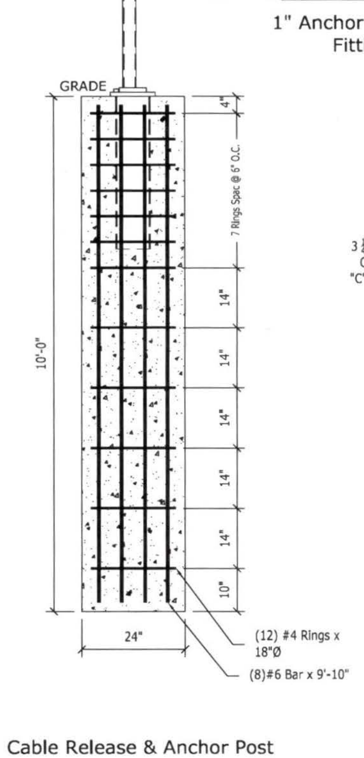
Figure 3 Summary of Test 4-12

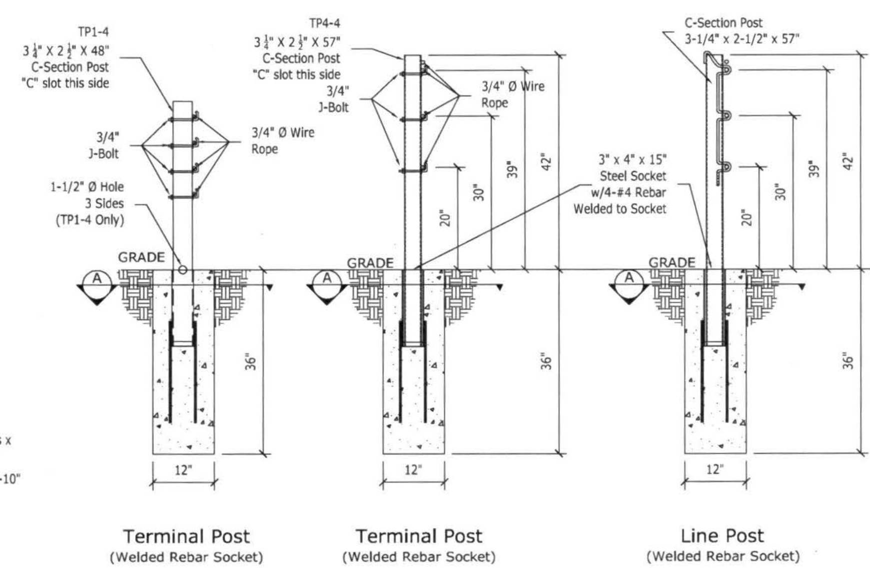
Return to Table of Contents

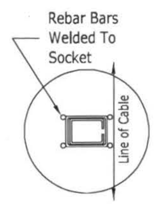












TL-4 4 Cable MASH Test and Post Spacing Chart

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

*±6" post spacing tolerance
**All tests are impacted near the midpoint of the installation at a 25° angle, except the 4-12 test, which is impacted at 15°.

Cable Tension Chart*

-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%

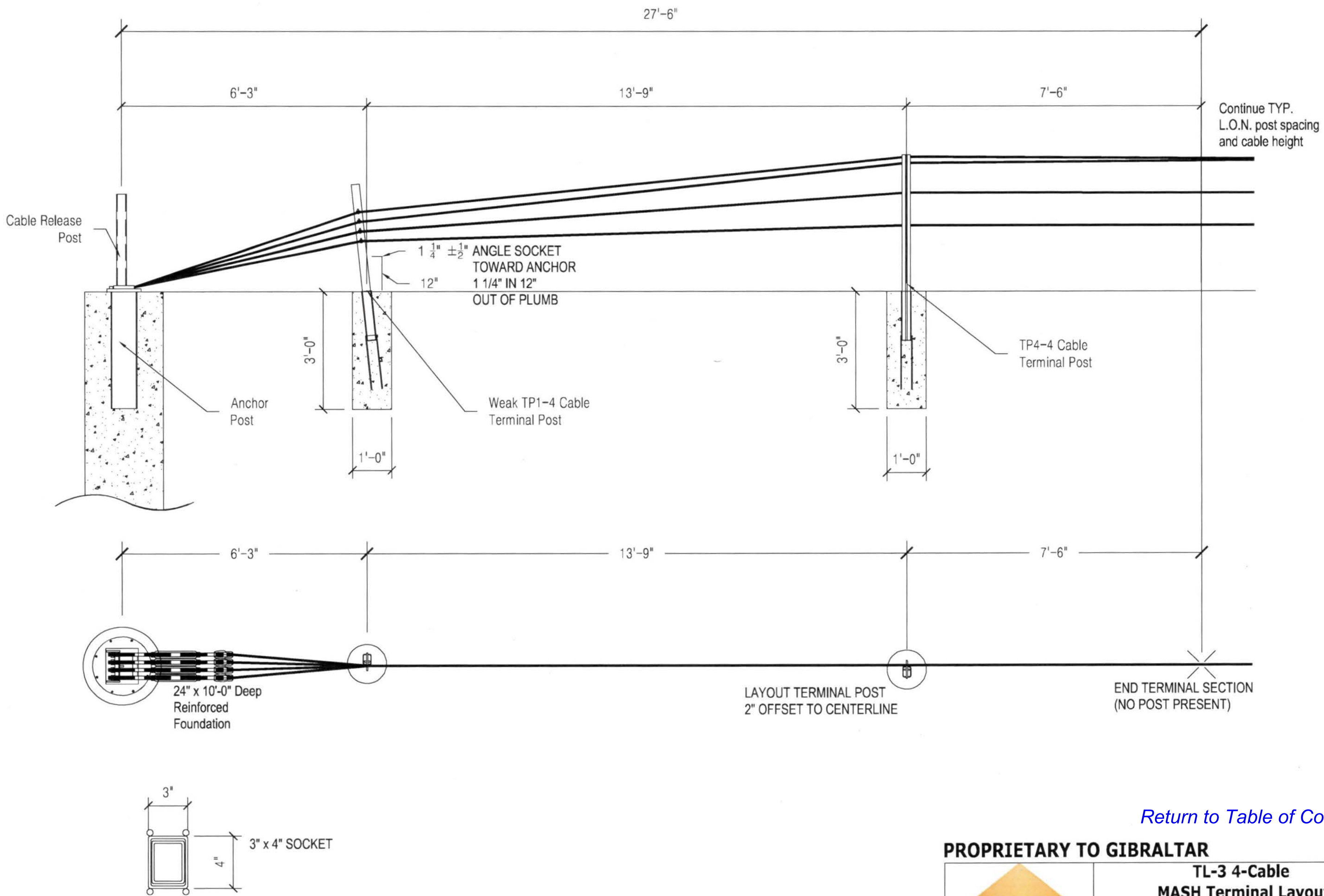
MASH 4 Cable Tests
PROPRIETARY TO GIBRALTAR

TL-4 4 Cable System Layout

Gibraltar Cable Barrier Systems

Scale: NTS	Date: 12-19-18
Layout: ANSI B	Drafter: JP

Rev Date:	Approver:
1-7-19	BH



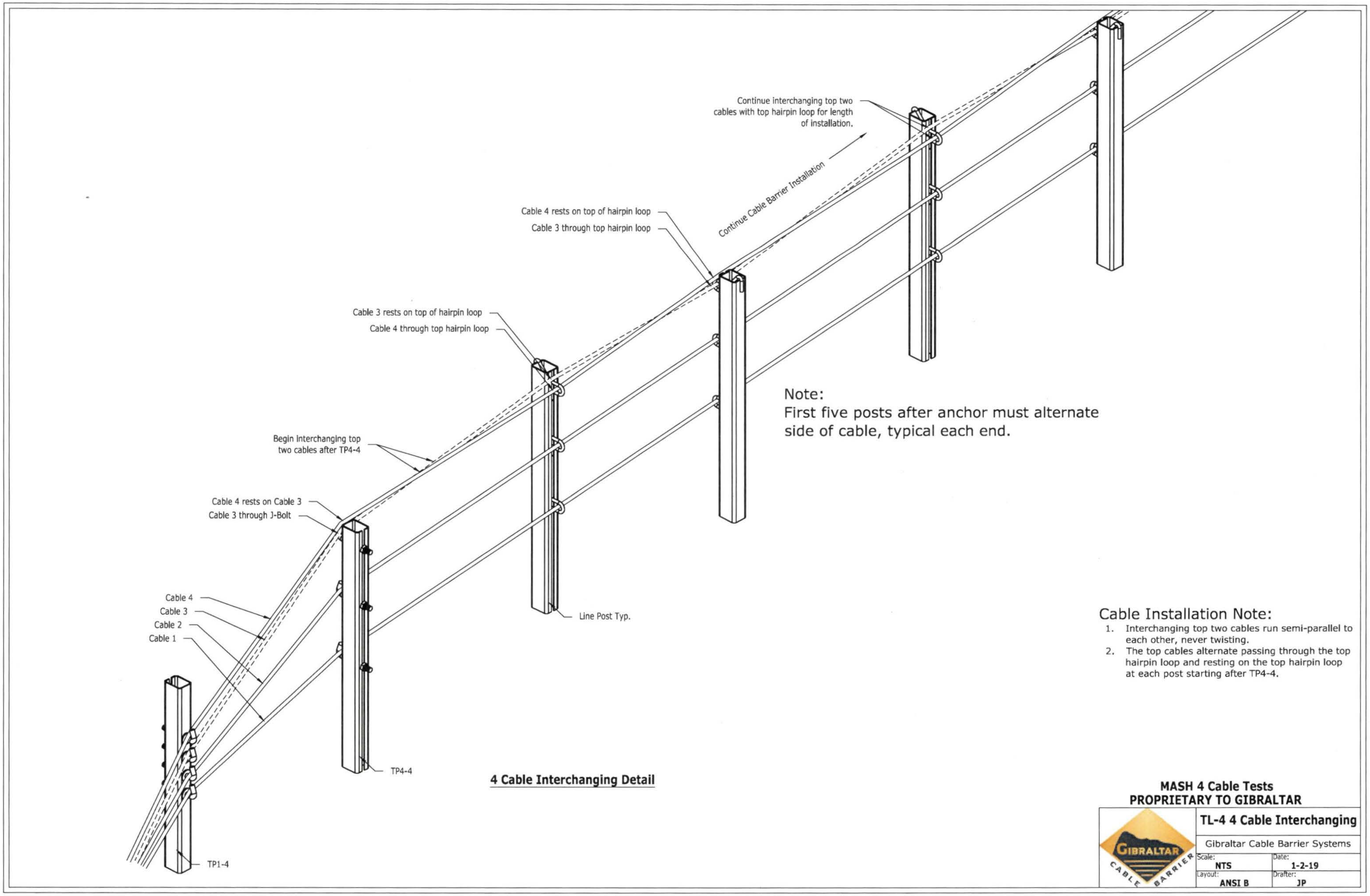
Return to Table of Contents

PROPRIETARY TO GIBRALTAR

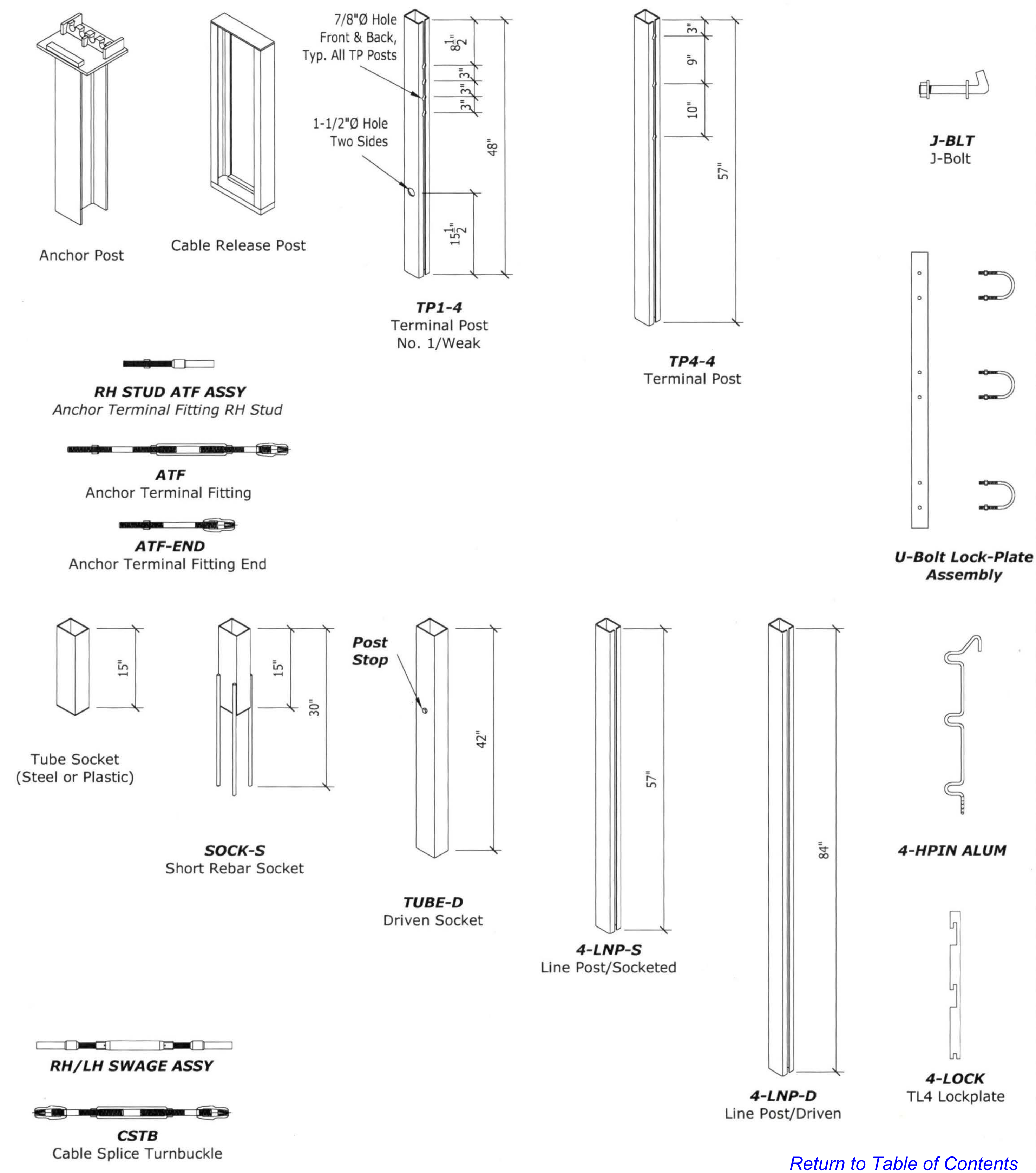
TL-3 4-Cable
MASH Terminal Layout

Gibraltar Cable Barrier Systems

Scale: NTS	Date: 1-7-19
Layout: ANSI B	Drafter: BH



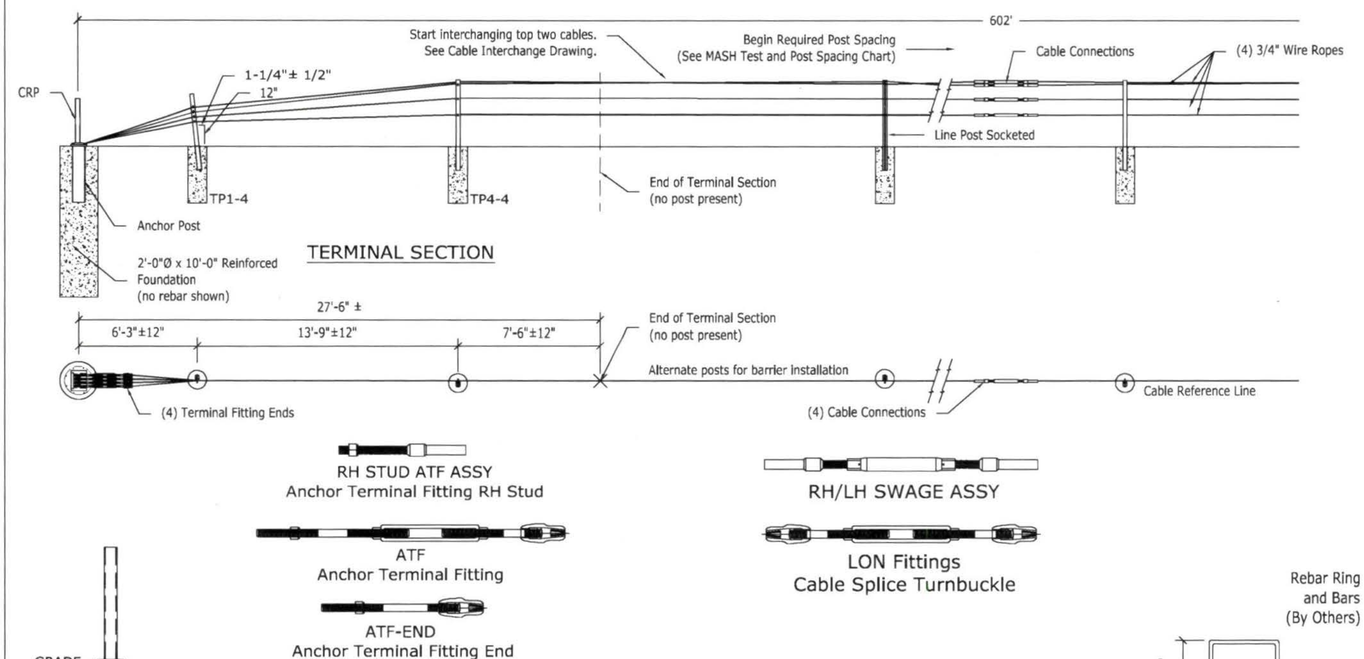
Return to Table of Contents

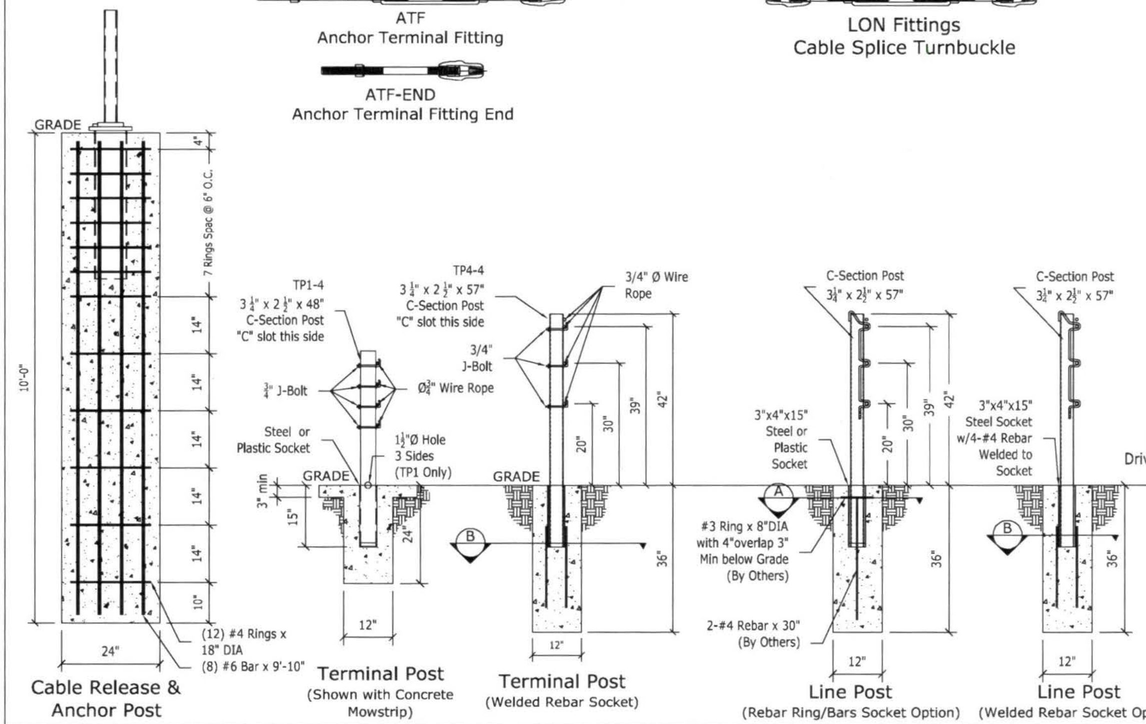


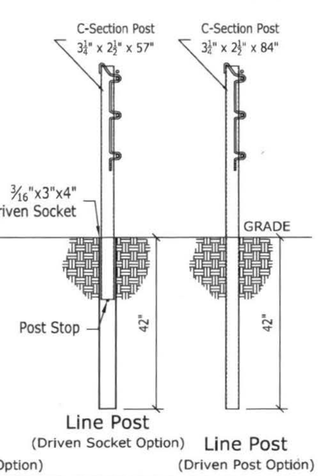
Return to Table of Contents

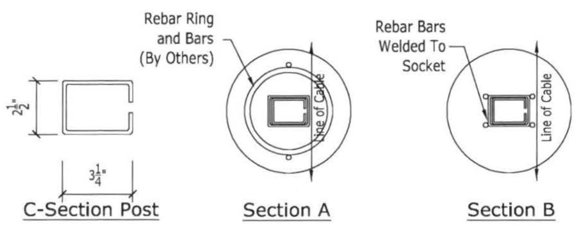
PROPRIETARY TO GIBRALTAR

GIBRALTAR CABLE BARRIER	**TL4 MASH System Parts**	
	Gibraltar Cable Barrier Systems	
	Scale: **NTS**	Date: **12/19/18**
	Layout: **ANSI B**	Drafter: **BH**









GENERAL NOTES:

1. For additional information contact Gibraltar, Inc. at 1-833-715-0810 or see the manufacturer's product manual.
2. All concrete shall be per specification; minimum 2500 PSI.
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 Spacing 18' on 4:1)
4. The Cable Barrier System is accepted by the FHWA Test Level - 4.
5. See the specification for delineation.
6. Rock Clause: Where solid rock is encountered:
   - 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.
7. The Gibraltar cable barrier system shall be installed in standard compacted soil. Soil must be well drained.
8. All non-welded rebar by others.
9. Minimum recommended line post foundation.
   - 9.A. Without mowstrip, 36" Deep x 12" diameter foundations with #3 rebar ring x 8" diameter with two #4 rebar vertical bars 30" long or 30" welded rebar socket.
   - 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 socket.
   - 9.C. With 3" minimum depth concrete mowstrip, 24" deep x 12" diameter foundations. (No rebar required).
   - 9.D. Direct drive driven post and driven socket 42" deep.

TL-4 4 Cable MASH Test and Post Spacing Chart

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

*±6" post spacing tolerance

Cable Tension Chart*

-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

Scale: NTS	Date: 1-7-2019
Layout: ANSI B	Drafter: BH

Return to Table of Contents

Return to Table of Contents

U.S. Department of Transportation
Federal Highway Administration

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

July 20, 2020

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. Griffith

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

Enclosures

Request for Federal Aid Reimbursement Eligibility of Highway Flexible Barriers

Submitter			
	Date of Request:	July 15, 2020	(●) New ( ) Resubmission
	Name:	Bruno Haesbaert	
	Company:	Applus IDIADA KARCOEngineering, LLC.	
	Address:	9270 Holly Road, Adelanto, CA 92301	
	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 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	SorD: 0to4ft. Offset SBP 4H:1V	(●) 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

Help

PRODUCT DESCRIPTION

(•) New Hardware or 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 pins and steel lock plates. The C-section posts were placed on alternating sides of the cables and aluminum hair pins held the cables in place. The top two (2) cables of the system were stitched together making the cables alternate in the top hairpin location. The hair pins held the cables at 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 as-tested length was 613.7 ft. (187.1 m) long. As recommended in MASH the cable tension was set 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:1V Ditch narrowest: 7.0 ft. (2.1 m)
- 4h:1V Ditch widest: 16.0 ft. (4.9 m).

Test 4-10 and 4-11 were tested on flat terrain and were run as a 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 AASHTO M147-65 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 options such 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-3 4 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 Number	Narrative Description	Evaluation 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

Required Test Number	Narrative Description	Evaluation Results
3-11 (2270P)	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. 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. 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.	PASS

3-13 (2270P)	Applus IDIADA KARCOEngineering Project number P38018-01 was conducted with a 2270P 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 ft. (2.1 m) was used. 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 speed and angle of 63.31 mph (101.89 km/h) and 25.7 degrees, respectively. The 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 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
3-14 (1100C)	Applus IDIADA KARCOEngineering Project number P38112-01 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 front 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. The test vehicle, a 2012 KiaRio with a test inertial weight of 2,428.4 lbs (1,101.5 kg) impacted the system at aspeed and angle of 60.97 mph (98.12 km/h) and 25.3 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 deformation limits were not exceeded. The Occupant Impact Velocities (OIV) and ridedown accelerations are within the recommended limits.	PASS
3-15 (1100C)	Per MASH 2016 this test is not applicable for V-ditches greater than or equal to 26 ft, measured from the front SBP to the back SBP. This test isalso not necessary for double median systems placed within a median ditch, one on each side and 0 to 4 ft from aSBP.	Non-Relevant Test, not conducted

3-16 (2270P)	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. The test vehicle, a 2009 KiaRio with a test inertial weight of 2,431.7 lbs (1,103.0 kg) entering the ditch at a speed 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
3-17 (1500A)	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. 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 a speed 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

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 (OIV) and ridedown accelerations are within the recommended limits.	PASS

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	
Laboratory Signature:	Bruno Haesbaert Digitally signed by Bruno Haesbaert Date: 2020.07.15 15:58:04 -07'00'	
Address:	9270 Holly Road, Adelanto, CA 92301	Same as Submitter ☐
Country:	United States of America	Same as Submitter ☐
Accreditation Certificate Number and Dates of current Accreditation period :	TL-371: July 2019 - July 2022	

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

Submit Form

ATTACHMENTS

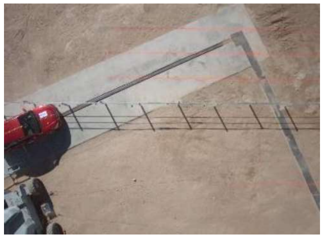
Attach to this form:

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

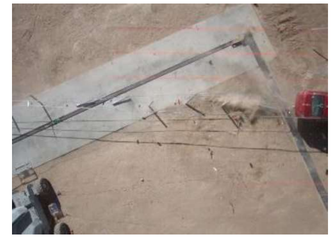
MASH Test 4-10 Summary

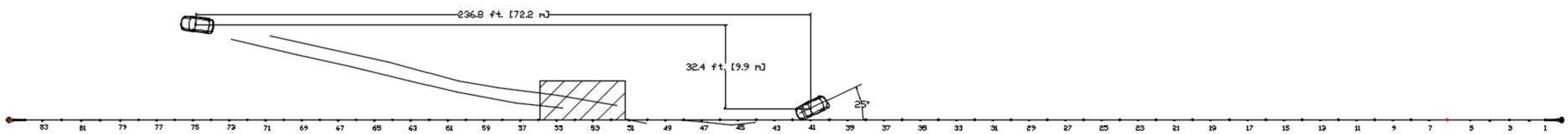

0.000 s


0.200 s


0.400 s


0.600 s


0.800 s



GENERAL INFORMATION	
Test Agency…………………	Applus IDIADA KARCO
KARCO Test No……………	P3791-01
Test Designation………..	4-10
Test Date………………..	12/06/17
TEST ARTICLE	
Name / Model………………	TL-4 Cable Barrier System
Type………………………..	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 lbs (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)

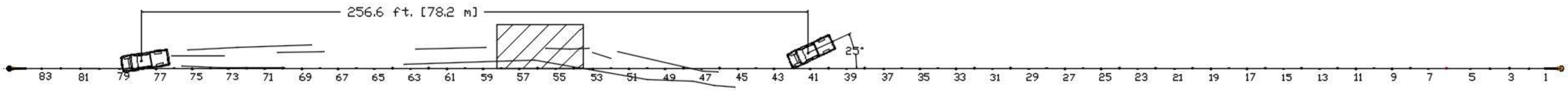
Impact Conditions	
Impact Velocity……………	62.38 mph (100.39 km/h)
Impact Angle………………	25.1°
Location / Orientation……	3.5 ft. (1.1 m) upstream of Post 42
Impact Severity…………	56.8 kip-ft (77.0 kJ)
Exit Conditions	
Exit Velocity………………	50.2 mph (80.8 km/h)
Exit Angle…………………	7.1°
Final Vehicle Position……	236.8 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 Angle……	8.3°
Maximum Yaw Angle……	-30.0°

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
Vehicle Damage	
Vehicle Damage Scale…….	11LFQ6
CDC…………………………	11LYAK8
Maximum Intrusion………..	1.0 in. (25 mm)

Figure 3 Summary of Test 4-10

MASH Test 4-11 Summary

0.000 s | 0.200 s | 0.300 s | 0.500 s | 0.700 s



GENERAL INFORMATION	
Test Agency……………..	Applus IDIADA KARCO
KARCO Test No…………..	P37358-01
Test Designation………..	4-11
Test Date………………….	12/07/18
TEST ARTICLE	
Name / Model……………	TL-4 Cable Barrier System
Type……………………….	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
TEST VEHICLE	
Type / Designation……..	2270P
Year, Make, and Model….	2013 Chevrolet Silverado 1500
Curb Mass………………….	5,261.2 lbs (2,386.5 kg)
Test Inertial Mass………….	5,011.0 lbs (2,273.0 kg)
Gross Static Mass………….	5,011.0 lbs (2,273.0 kg)

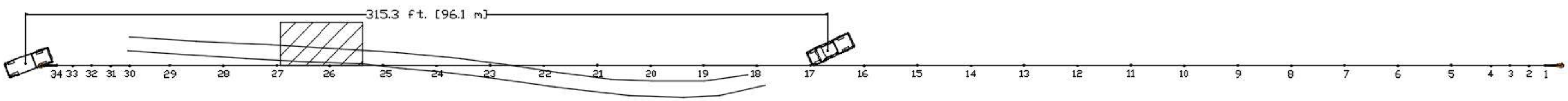
Impact Conditions	
Impact Velocity…………..	60.93 mph (98.06 km/h)
Impact Angle………………	25.3°
Location / Orientation………	1.5 in. upstream from Post 42
Impact Severity…………….	113.6 kip-ft (154.0 kJ)
Exit Conditions	
Exit Velocity…………………	36.7 mph (59.1 km/h)
Exit Angle……………………	6.2°
Final Vehicle Position………	256.6 ft. (78.2 m) Downstream 3.1 ft. (0.9 m) Right
Exit Box Criterion………….	Exited within exit box
Vehicle Snagging………….	None
Vehicle Pocketing………….	None
Maximum Roll Angle………	5.4 °
Maximum Pitch Angle………	3.6 °
Maximum Yaw Angle………	-26.3 °

Occupant Risk	
Longitudinal OIV……………	9.2 ft/s (2.8 m/s)
Lateral OIV………………….	12.1 ft/s (3.7 m/s)
Longitudinal RA…………….	-4.0 g
Lateral RA……………………	5.6 g
THIV………………………….	15.7 ft/s (4.8 m/s)
PHD………………………….	5.3 g
ASI…………………………….	0.41
Test Article Deflections	
Static…………………………	0.5 ft. (0.2 m)
Dynamic…………………….	7.9 ft. (2.4 m)
Working Width………………	7.9 ft. (2.4 m)
Debris Field…………………	10.0 ft. (3.0 m) Field side
Vehicle Damage	
Vehicle Damage Scale…….	11-LFQ-3
CDC…………………………	11LYEW2
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 | 0.800 s



GENERAL INFORMATION	
Test Agency	Applus IDIADA KARCO
KARCO Test No.	P37359-01
Test Designation	4-11
Test Date	12/07/18
TEST ARTICLE	
Name / Model	TL-4 Cable Barrier System
Type	Longitudinal Barrier
Installation Length	597.7 ft. (182.2 m)
Post Spacing	21.0 ft. (6.4 m)
Key Elements	Cable, Hair Pins, Lock Plates
Road Surface	Concrete and Soil
TEST VEHICLE	
Type / Designation	2270P
Year, Make, and Model	2013 Chevrolet Silverado 1500
Curb Mass	5,067.2 lbs (2,298.5 kg)
Test Inertial Mass	5,028.7 lbs (2,281.0 kg)
Gross Static Mass	5,028.7 lbs (2,281.0 kg)

Impact Conditions	
Impact Velocity	61.78 mph (99.43 km/h)
Impact Angle	25.1°
Location / Orientation	11.5 in. (292 mm) upstream from post 17
Impact Severity	115.5 kip-ft (156.5 kJ)
Exit Conditions	
Exit Velocity	47.40 mph (76.28 km/h)
Exit Angle	2.4°
Final Vehicle Position	315.3 ft. (96.1 m) Downstream 0.7 ft. (0.2 m) Traffic side
Exit Box Criteria Met	Yes
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Maximum Roll Angle	-3.1 °
Maximum Pitch Angle	-2.9 °
Maximum Yaw Angle	-25.7 °

Occupant Risk	
Longitudinal OIV	8.5 ft/s (2.6 m/s)
Lateral OIV	9.5 ft/s (2.9 m/s)
Longitudinal RA	-2.6 g
Lateral RA	3.4 g
THIV	13.1 ft/s (4.0 m/s)
PHD	3.7 g
ASI	0.31
Test Article Deflections	
Static	N/A
Dynamic	13.8 ft. (4.2 m)
Working Width	13.8 ft. (4.2 m)
Debris (lateral)	14.5 ft. (4.4 m)
Vehicle Damage*	
Vehicle Damage Scale	11-LFQ-3
CDC	11LFEN2
Maximum Intrusion	none

*Vehicle damaged assessed before secondary impact.

Figure 4 Summary of Test 4-11

Return to Table of Contents

MASH Test 3-13 Summary

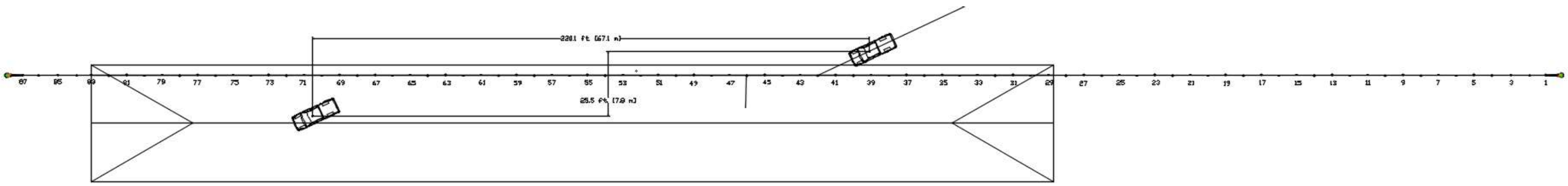
0.000 s

0.300 s

0.700 s

1.400 s

3.330 s



GENERAL INFORMATION	
Test Agency	Applus IDIADA KARCO Engineering
Test No.	P38018-01
Test Designation	3-13
Test Date	03/20/18
TEST ARTICLE	
Name / Model	TL-4 Cable Barrier System
Type	Longitudinal Barrier
Installation Length	613.7 ft. (187.1 m)
Key Elements	Cable, Hair Pins, Lock Plates
Road Surface	AASHTO M147-65 Grade B
Post Spacing	7.0 ft. (2.1 m)
TEST VEHICLE	
Type / Designation	2270P
Year, Make, and Model	2012 Chevrolet Silverado 1500
Curb Mass	5,134.5 lbs (2,329.0 kg)
Test Inertial Mass	5,026.5 lbs (2,280.0 kg)
Gross Static Mass	5,026.5 lbs (2,280.0 kg)

Impact Conditions	
Impact Velocity	63.31 mph (101.89 km/h)
Impact Angle	25.7°
Target Location	1.0 ft. upstream of post no. 41
Impact Severity	126.7 kip-ft (171.7 kJ)
Exit Conditions	
Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	220.1 ft. (67.1 m) 25.5 ft. (7.8 m)
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	Satisfactory
Maximum Roll Angle*	-111.6 °
Maximum Pitch Angle	16.1 °
Maximum Yaw Angle	-15.1 °

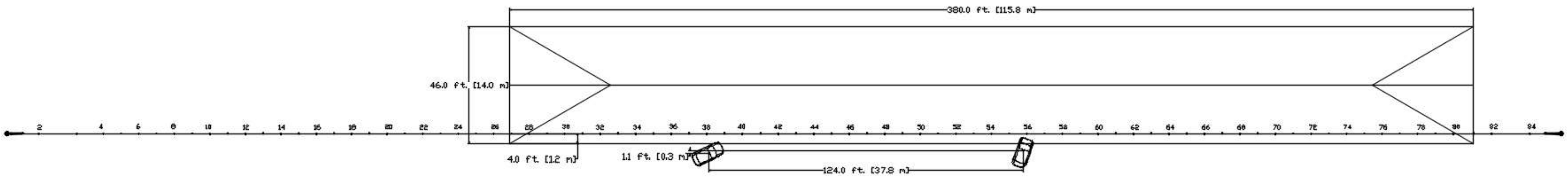
*Channel malfunction

Occupant Risk	
Longitudinal OIV	5.9 ft/s (1.8 m/s)
Lateral OIV	6.6 ft/s (2.0 m/s)
Longitudinal RA	-2.6 g
Lateral RA	2.5 g
THIV	7.9 ft/s (2.4 m/s)
PHD	2.9 g
ASI	0.24
Test Article Deflections	
Static	2.1 ft (0.6 m)
Dynamic	11.0 ft (3.4 m)
Working Width	12.5 ft (3.8 m)
Debris Field Lateral	23.0 ft. (7.0 m)
Vehicle Damage	
Vehicle Damage Scale	11-LFQ-3
CDC	11LYEW2
Maximum Intrusion	0.25 in. (6.4 mm)

Figure 3 Summary of Test 3-13

MASH Test 3-14 Summary

0.000 s 0.200 s 0.400 s 0.600 s 1.600 s



GENERAL INFORMATION

Test Agency……………..	Applus IDIADA KARCO Engineering
Test No………………	P38112-01
Test Designation……………	3-14
Test Date……………………	04/02/18

TEST ARTICLE

Name / Model………………	TL-4 Cable Barrier System
Type…………………………	Longitudinal Barrier
Installation Length………….	613.7 ft. (187.1 m)
Key Elements……………….	Cable, Hair Pins, Lock Plates
Road Surface……………….	AASHTO M147-65 Grade B
Post Spacing………………	7.0 ft. (2.1 m)

TEST VEHICLE

Type / Designation…………	1100C
Year, Make, and Model……	2012 Kia Rio
Curb Mass…………………..	2,401.9 lbs (1,089.5 kg)
Test Inertial Mass………….	2,428.4 lbs (1,101.5 kg)
Gross Static Mass………….	2,599.2 lbs (1,179.0 kg)

Impact Conditions

Impact Velocity…………….	60.97 mph (98.12 km/h)
Impact Angle…………………	25.3°
Location / Orientation………	Midspan between posts
Impact Severity………………	55.1 kip-ft (74.7 kJ)

Exit Conditions

Exit Velocity…………………	Vehicle did not exit
Exit Angle……………………	N/A
Final Vehicle Position………	124.0 ft. (37.8 m) Downstream 1.1 ft. (0.3 m) Left
Exit Box Criteria Met………	N/A
Vehicle Snagging……………	None
Vehicle Pocketing………….	Satisfactory
Maximum Roll Angle……….	48.6 °
Maximum Pitch Angle………	16.6 °
Maximum Yaw Angle……….	-55.0 °

Occupant Risk

Longitudinal OIV……………	10.8 ft/s (3.3 m/s)
Lateral OIV………………….	14.1 ft/s (4.3 m/s)
Longitudinal RA…………….	-4.9 g
Lateral RA…………………..	7.5 g
THIV………………………….	25.9 ft/s (7.9 m/s)
PHD…………………………..	7.7 g
ASI……………………………	0.64

Test Article Deflections

Static…………………………	0.5 ft (0.2 m)
Dynamic……………………..	5.5 ft (1.7 m)
Working Width………………	5.5 ft (1.7 m)
Debris (lateral)………………	27.0 ft. (8.2 m)

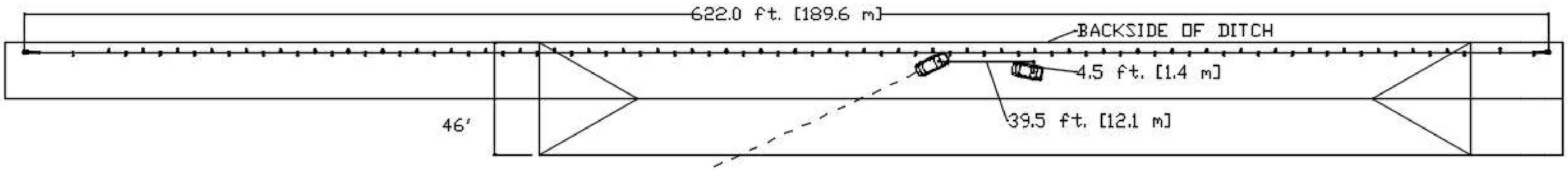
Vehicle Damage

Vehicle Damage Scale…….	11-LFQ-4
CDC…………………………..	11LYAW3
Maximum Intrusion…………	0.4 in. (10 mm)

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	
Test Agency	Applus IDIADA KARCO
Test No.	P39320-01
Test Designation	3-16
Test Date	11/05/19
TEST ARTICLE	
Name / Model	TL-4 Cable Barrier System
Type	Longitidinal Barrier
Installation Length	622.0 ft. (189.6 m)
Key Elements	Cable, Hair Pins, Lockplates
Road Surface	AASHTO M147-65 Grade B
Post Spacing	7.0 ft. (2.1 m)
TEST VEHICLE	
Type / Designation	1100C
Year, Make, and Model	2009 Kia Rio
Curb Mass	2,353.4 lbs (1,067.5 kg)
Test Inertial Mass	2,431.7 lbs (1,103.0 kg)

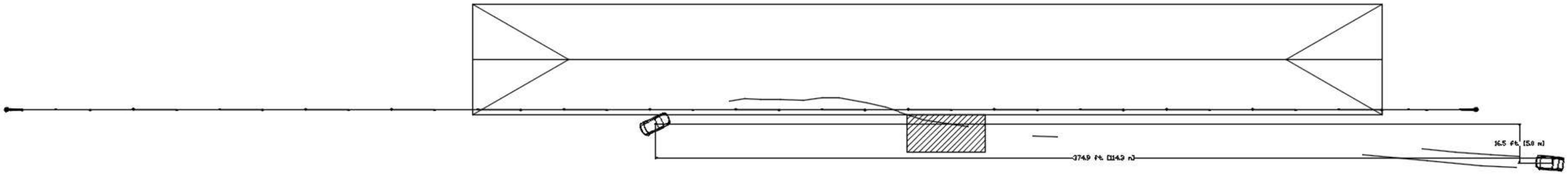
Impact Conditions	
Impact Velocity	61.91 mph (99.63 km/h)
Impact Angle	25.0°
Location / Orientation	1.6 in. downstream from intended
Impact Severity	55.6 kip-ft (75.4 kJ)
Exit Conditions	
Exit Velocity	14.04 mph (22.60 km/h)
Exit Angle	9.5°
Final Vehicle Position	39.5 ft. (12 m) Downstream 4.5 ft. (1.4 m) Right
Exit Box Criteria Met	Yes
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Vehicle Stability	Satisfactory
Maximum Roll Angle	-69.4 °
Maximum Pitch Angle	50.5 °
Maximum Yaw Angle	-44.3 °

Occupant Risk	
Longitudinal OIV	0.7 ft/s (0.2 m/s)
Lateral OIV	-3.3 ft/s (-1.0 m/s)
Longitudinal RA	-11.2 g
Lateral RA	5.1 g
THIV	3.3 ft/s (1.0 m/s)
PHD	11.4 g
ASI	0.84
Test Article Deflections	
Static	0.1 ft. (0.6 m)
Dynamic	2.1 ft. (0.6 m)
Working Width	3.0 ft (0.9 m)
Debris Field	No debris field
Vehicle Damage	
Vehicle Damage Scale	11-LFQ-1
CDC	11FDEK1 and 11LFES1
Maximum Intrusion	0.4 in. (10 mm) at toepan

Figure 2 Summary of Test 3-16

MASH Test 3-17 Summary

0.000 s | 0.075 s | 0.150 s | 0.200 s | 0.550 s



GENERAL INFORMATION

Test Agency…………………… Applus IDIADA KARCO Engineering
Test No……………………..…. P38113-02
Test Designation…………… 3-17
Test Date…………………… 04/30/18

TEST ARTICLE

Name / Model……………… TL-4 Cable Barrier Sytem
Type…………………………… Longitudinal Barrier
Installation Length………… 614.4 ft. (187.3 m)
Key Elements……………… hair pins,lock plate, cable
Road Surface……………… AASHTO M147-65 Grade B
Post Spacing……………… 18.0 ft. (5.5 m)

TEST VEHICLE

Type / Designation………… 1500A
Year, Make, and Model…… 2012 Chevy Malibu
Curb Mass…………………… 3,360.9 lbs (1,524.5 kg)
Test Inertial Mass………… 3,244.0 lbs (1471.5 kg)
Gross Static Mass………… 3,244.0 lbs (1471.5 kg)

Impact Conditions

Impact Velocity……………. 64.73 mph (104.17 km/h)
Impact Angle………………… 24.6°
Location / Orientation……… Midspan between posts
Impact Severity……………… 78.7 kip-ft (106.8 kJ)

Exit Conditions

Exit Velocity………………… 33.31 mph (53.61 km/h)
Exit Angle…………………… 6.5°
Final Vehicle Position……… 374.9 ft. (114.3 m) Downstream
16.5 ft. (5.0 m) Traffic Side
Exit Box Criteria Met……… Yes
Vehicle Snagging…………… None
Vehicle Pocketing…………… Satisfactory
Maximum Roll Angle……… -29.9 °
Maximum Pitch Angle……… 15.3 °
Maximum Yaw Angle……… 33.7 °

Occupant Risk

Longitudinal OIV…………… 11.2 ft/s (3.4 m/s)
Lateral OIV………………… 17.1 ft/s (5.2 m/s)
Longitudinal RA…………… -2.3 g
Lateral RA………………… 4.0 g
THIV………………………… 41.3 ft/s (12.6 m/s)
PHD………………………… 4.0 g
ASI………………………… 0.37

Test Article Deflections

Static……………………… 0.5 ft (0.2 m)
Dynamic…………………… 13.5 ft (4.1 m)
Working Width…………… 13.5 ft (4.1 m)
Debris (lateral)…………… 23.0 ft. (7.0 m)

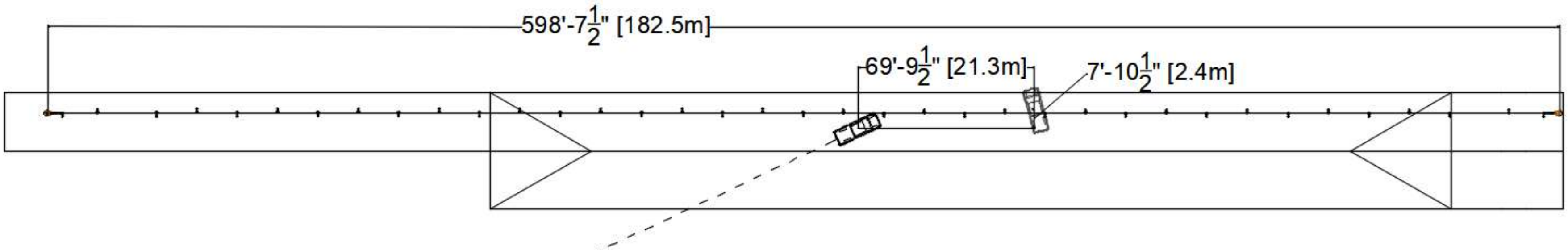
Vehicle Damage

Vehicle Damage Scale…… 11-LFQ-4
CDC………………………… 11LYEW3
Maximum Intrusion……… 0.7 in. (17 mm)

Figure 3 Summary of Test 3-17

MASH 2016 Test 3-18 Summary

1.175 s | 1.255 s | 1.335 s | 1.655 s | 1.815 s | 1.975 s



GENERAL INFORMATION

Test Agency	Applus IDIADA KARCO
Test No.	P40079-01
Test Designation	3-18
Test Date	04/23/20

TEST ARTICLE

Name / Model	TL-4 Cable Barrier System
Type	Longitidinal Barrier
Installation Length	598.6 ft. (182.5 m)
Key Elements	Cable, Hair Pins, Lockplates
Road Surface	AASHTO M147-65 Grade B
Post Spacing	16.0 ft. (4.9 m)

TEST VEHICLE

Type / Designation	2270P
Year, Make, and Model	2016 Chevrolet Silverado
Curb Mass	5,145.5 lbs (2,334.0 kg)
Test Inertial Mass	5,011.0 lbs (2,273.0 kg)
Gross Static Mass	5,011.0 lbs (2,273.0 kg)

Impact Conditions

Impact Velocity	62.92 mph (101.26 km/h)
Impact Angle	25.1°
Location / Orientation	4.0 ft upstream from post 22
Impact Severity	119.3 kip-ft (161.8 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	69.8 ft. (21.3 m) Downstream 7.9 ft. (2.4 m) Left
Exit Box Criteria Met	Yes
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Vehicle Stability	Satisfactory
Maximum Roll Angle	-53.7 °
Maximum Pitch Angle	44.0 °
Maximum Yaw Angle	40.9 °

Occupant Risk

Longitudinal OIV	0.7 ft/s (0.2 m/s)
Lateral OIV	4.6 ft/s (1.4 m/s)
Longitudinal RA	-18.5 g
Lateral RA	-3.4 g
THIV	4.6 ft/s (1.4 m/s)
PHD	18.5 g
ASI	1.10

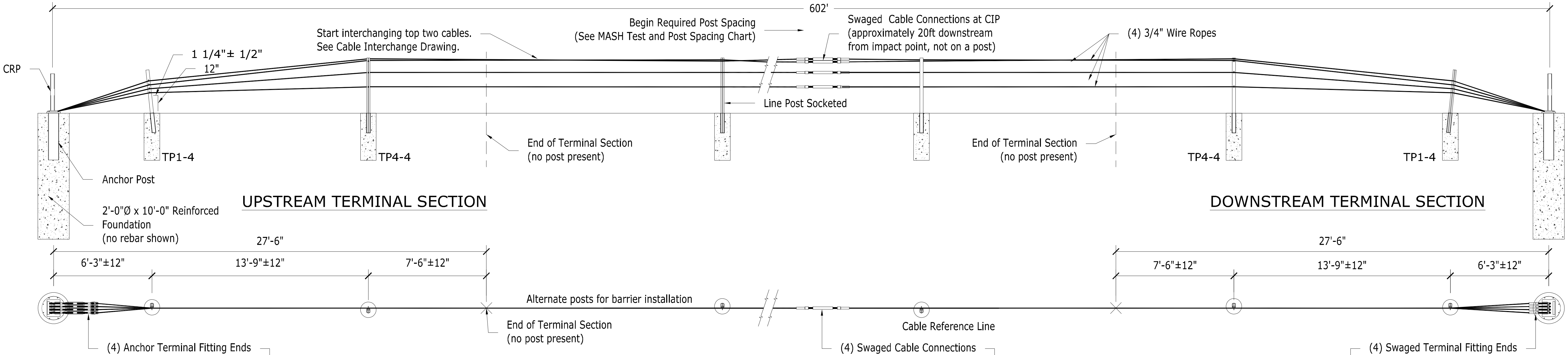
Test Article Deflections

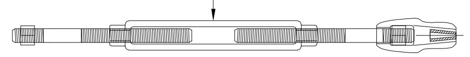
Static	0.3 ft. (0.9 m)
Dynamic	3.1 ft. (0.9 m)
Working Width	15.0 ft (4.6 m)
Debris Field	No debris field

Vehicle Damage

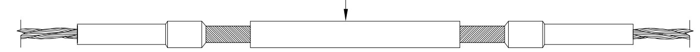
Vehicle Damage Scale	11-LFQ-1
CDC	11FDEK1 and 11LFES1
Maximum Intrusion	0.7 in. (18 mm) at toepan

Figure 2 Summary of Test 3-18

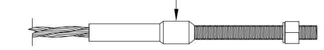




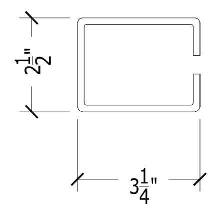
1" Anchor Terminal Fitting



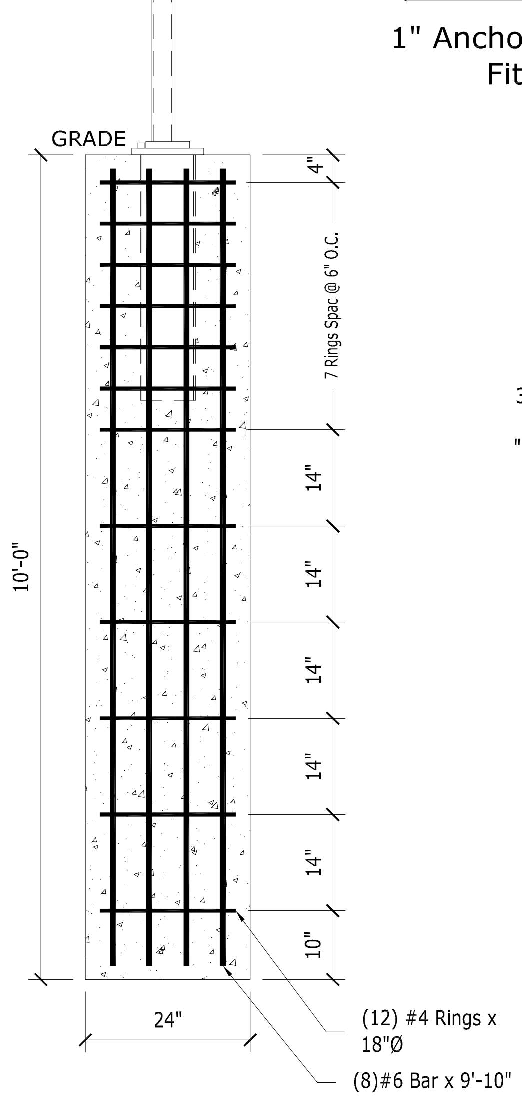
1" Swaged Cable Connection



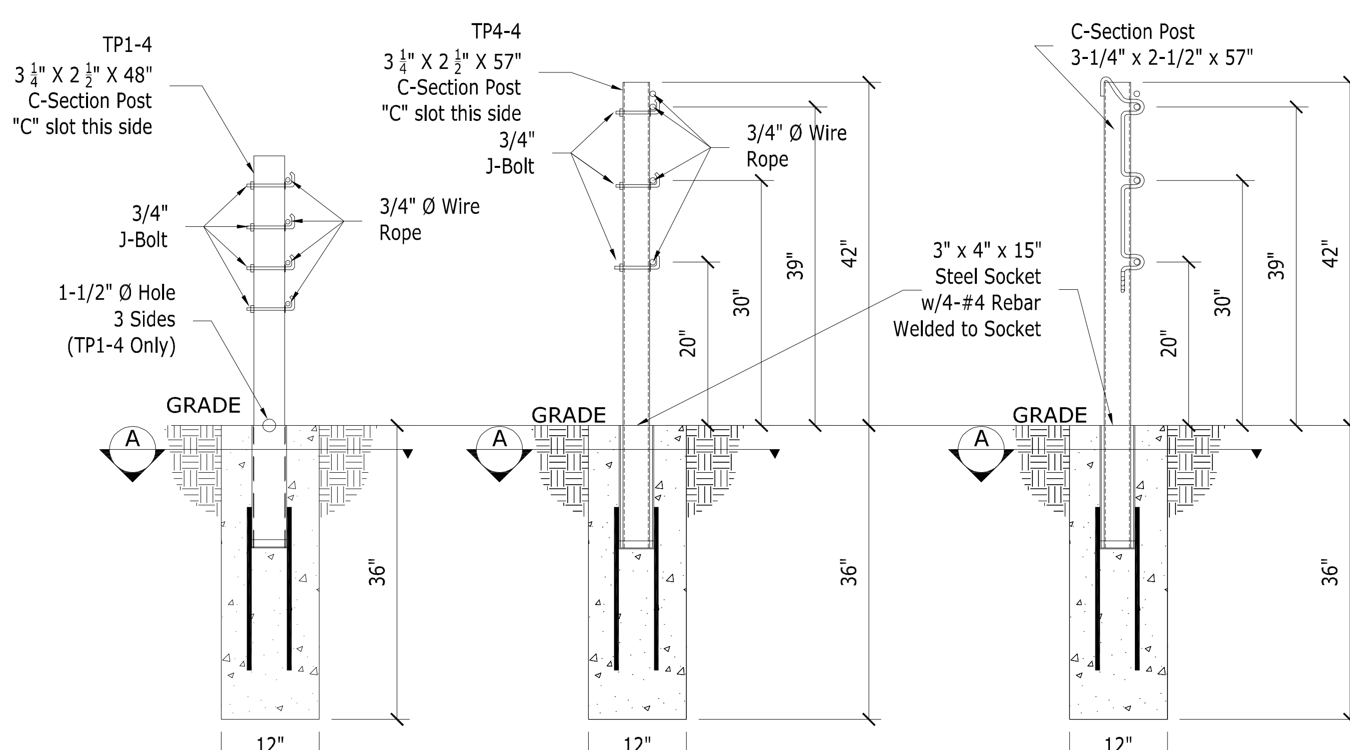
1" RH Swaged Terminal Fitting



C Section Post



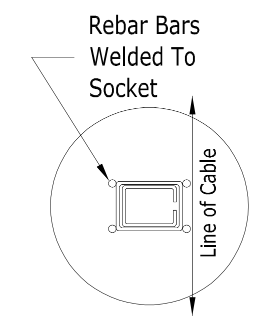
Cable Release & Anchor Post



Terminal Post
(Welded Rebar Socket)

Terminal Post
(Welded Rebar Socket)

Line Post
(Welded Rebar Socket)



Section A

TL-4 4 Cable MASH Test and Post Spacing Chart

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

*±6" post spacing tolerance
**All tests are impacted near the midpoint of the installation at a 25° angle, except the 4-12 test, which is impacted at 15°.

Cable Tension Chart*

-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%

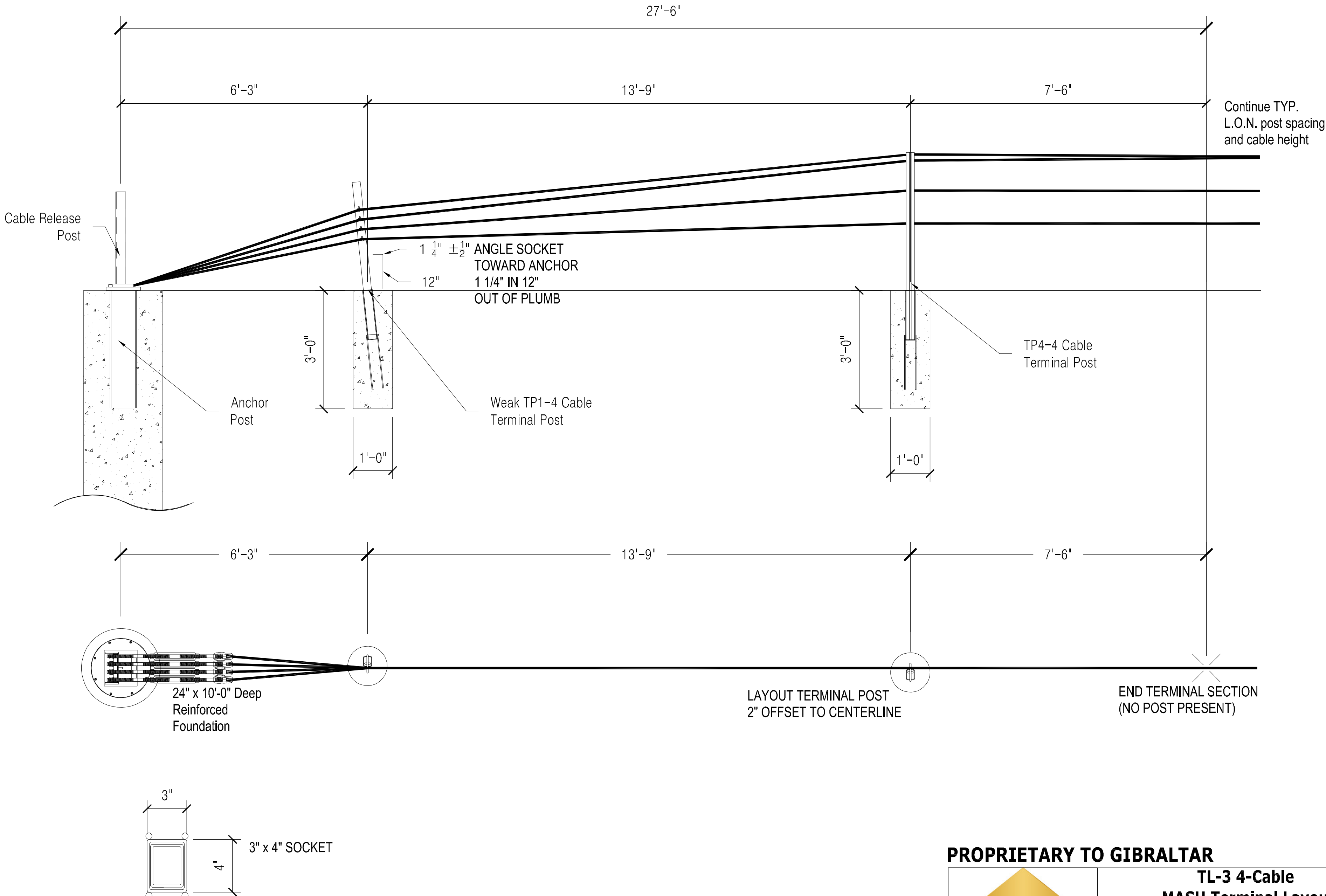
Return to Table of Contents

MASH 4 Cable Tests
PROPRIETARY TO GIBRALTAR

TL-4 4 Cable System Layout

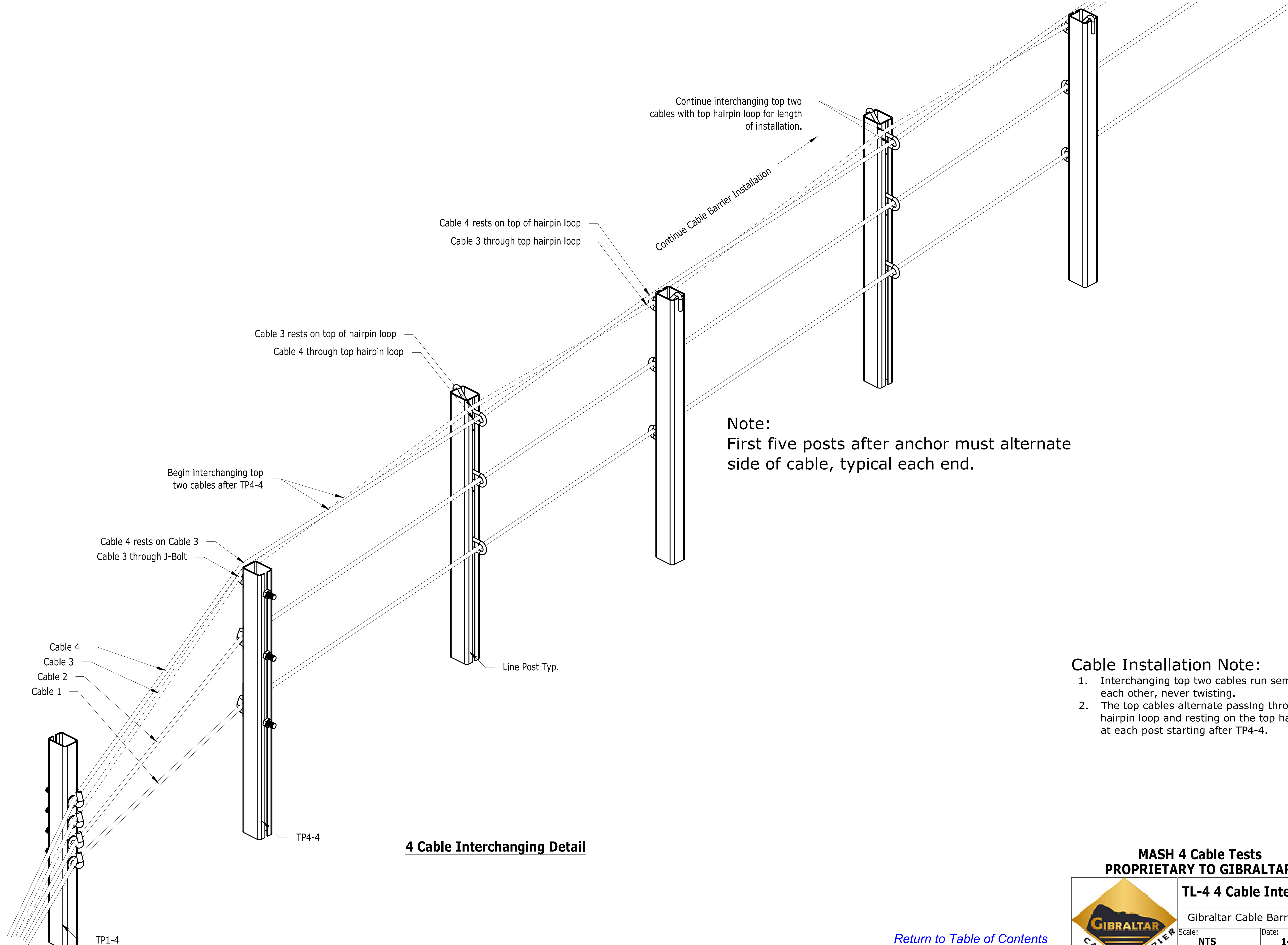
Gibraltar Cable Barrier Systems

Scale: NTS	Date: 12-19-18
Layout: ANSI B	Drafter: JP



PROPRIETARY TO GIBRALTAR

TL-3 4-Cable MASH Terminal Layout		
Gibraltar Cable Barrier Systems		
Scale: NTS	Date: 1-7-19	
Layout: ANSI B	Drafter: BH	



Note:
First five posts after anchor must alternate side of cable, typical each end.

Cable Installation Note:

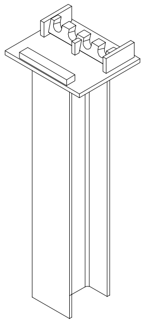
1. Interchanging top two cables run semi-parallel to each other, never twisting.
2. The top cables alternate passing through the top hairpin loop and resting on the top hairpin loop at each post starting after TP4-4.

4 Cable Interchanging Detail

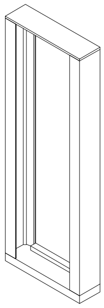
Return to Table of Contents

MASH 4 Cable Tests
PROPRIETARY TO GIBRALTAR

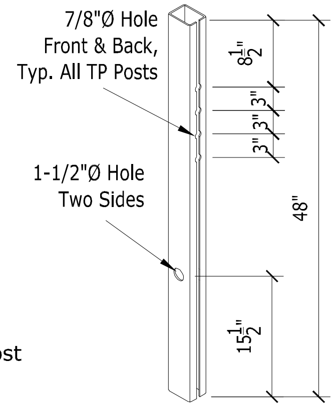
TL-4 4 Cable Interchanging	
Gibraltar Cable Barrier Systems	
Scale: NTS	Date: 1-2-19
Layout: ANSI B	Drafter: JP



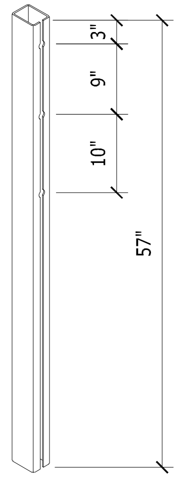
Anchor Post



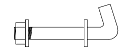
Cable Release Post



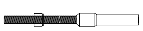
TP1-4
Terminal Post
No. 1/Weak



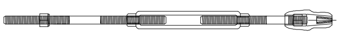
TP4-4
Terminal Post



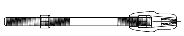
J-BLT
J-Bolt



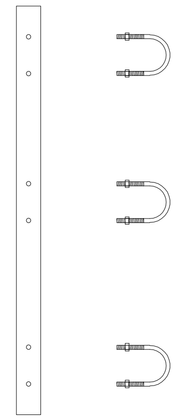
RH STUD ATF ASSY
Anchor Terminal Fitting RH Stud



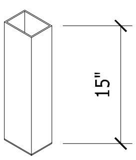
ATF
Anchor Terminal Fitting



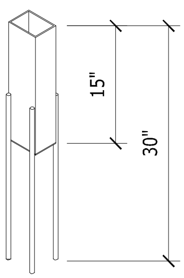
ATF-END
Anchor Terminal Fitting End



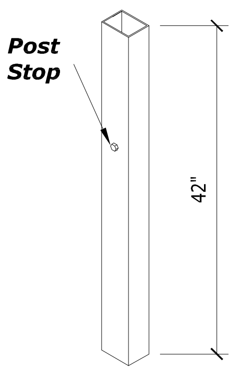
U-Bolt Lock-Plate Assembly



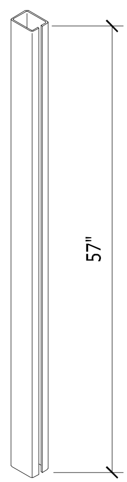
Tube Socket
(Steel or Plastic)



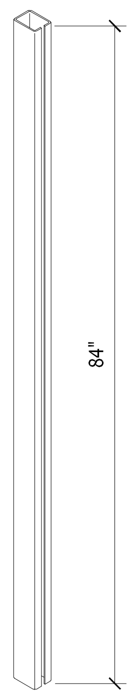
SOCK-S
Short Rebar Socket



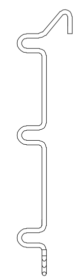
TUBE-D
Driven Socket



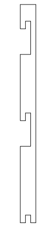
4-LNP-S
Line Post/Socketed



4-LNP-D
Line Post/Driven

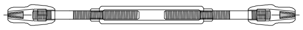


4-HPIN ALUM

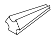


4-LOCK
TL4 Lockplate

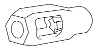
RH/LH SWAGE ASSY



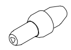
CSTB
Cable Splice Turnbuckle



WEDGE
W-1 Wedge



ACORN
Acorn w/ Wedge



TORP
Longitudinal Section ONLY
Torpedo Cable Splice

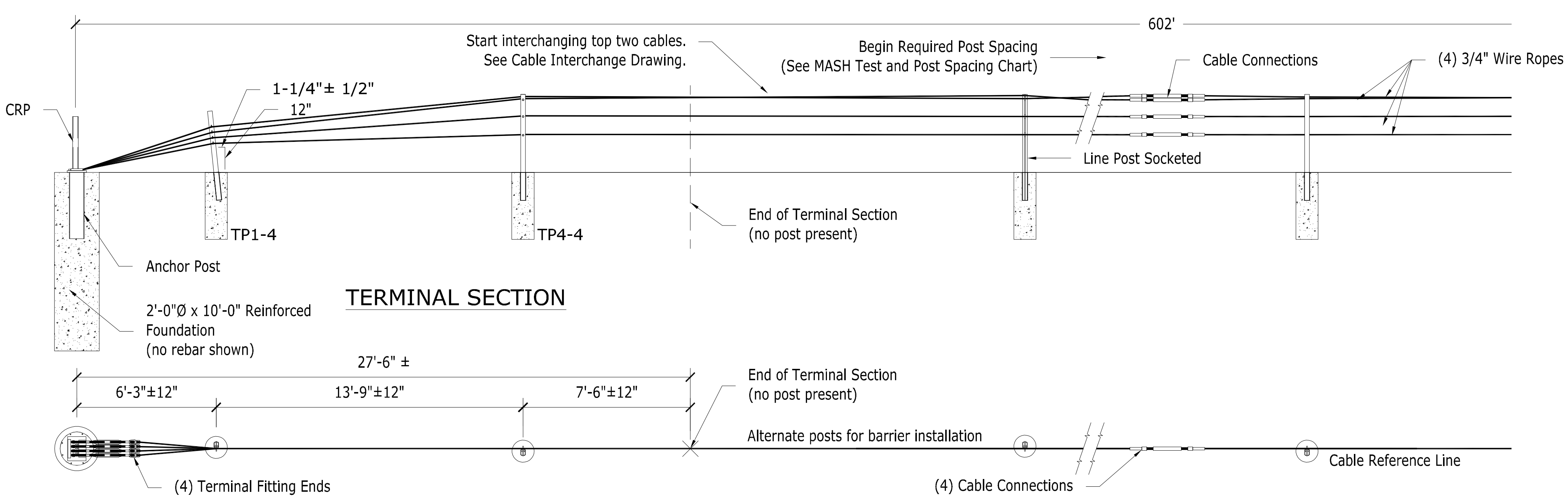
Return to Table of Contents

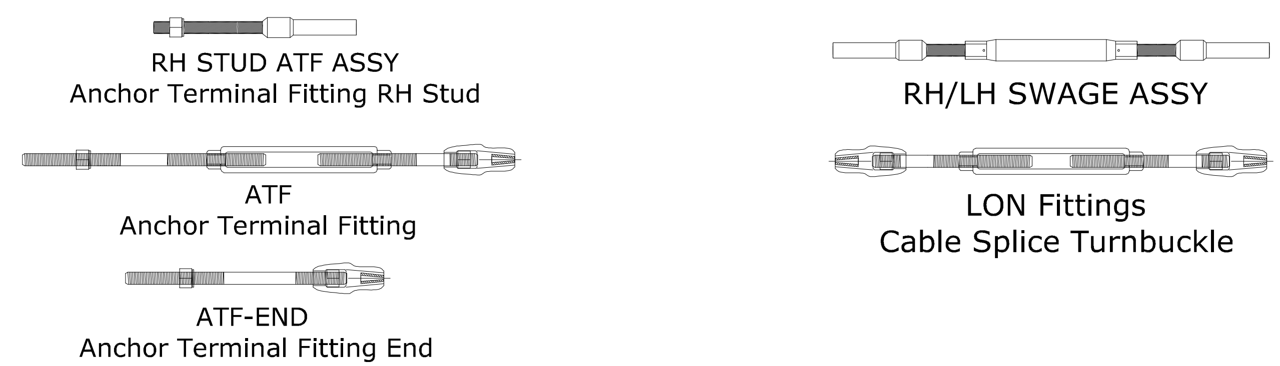
PROPRIETARY TO GIBRALTAR

TL4 MASH System Parts

Gibraltar Cable Barrier Systems

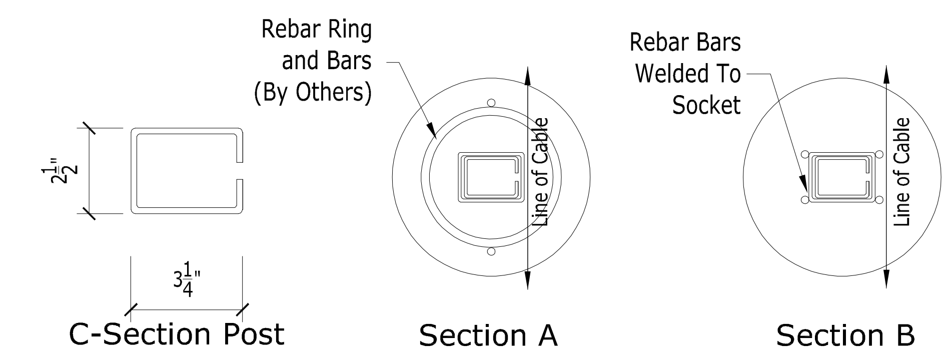
Scale: **NTS**
Date: **12/19/18**
Layout: **ANSI B**
Drafter: **BH**

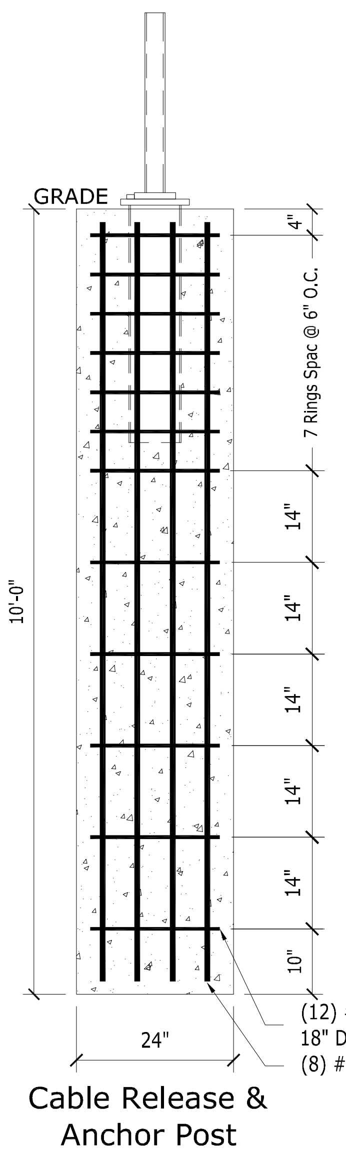


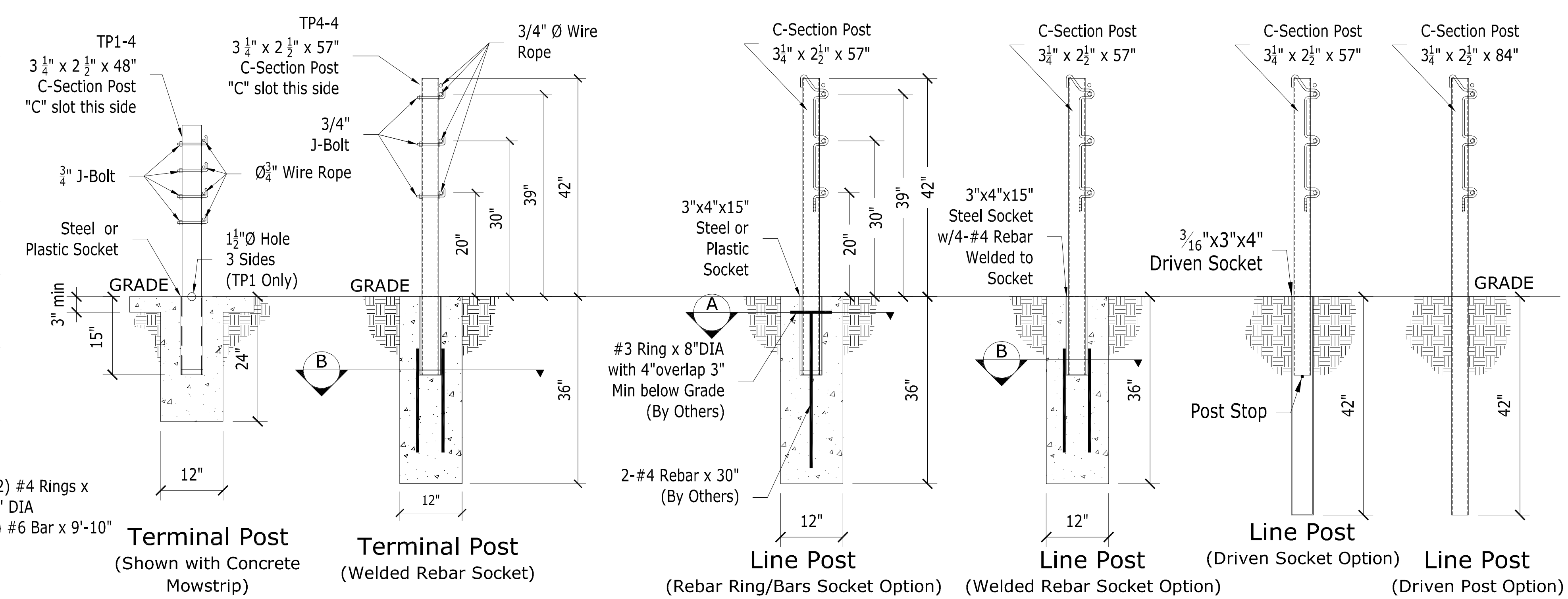


GENERAL NOTES:

1. For additional information contact Gibraltar, Inc. at 1-833-715-0810 or see the manufacturer's product manual.
2. All concrete shall be per specification; minimum 2500 PSI.
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 Spacing 18' on 4:1)
4. The Cable Barrier System is accepted by the FHWA Test Level - 4.
5. See the specification for delineation.
6. Rock Clause: Where solid rock is encountered:
   - 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.
7. The Gibraltar cable barrier system shall be installed in standard compacted soil. Soil must be well drained.
8. All non-welded rebar by others.
9. Minimum recommended line post foundation.
   - 9.A. Without mowstrip, 36" Deep x 12" diameter foundations with #3 rebar ring x 8" diameter with two #4 rebar vertical bars 30" long or 30" welded rebar socket.
   - 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 socket.
   - 9.C. With 3" minimum depth concrete mowstrip, 24" deep x 12" diameter foundations. (No rebar required).
   - 9.D. Direct drive driven post and driven socket 42" deep.







TL-4 4 Cable MASH Test and Post Spacing Chart

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

*±6" post spacing tolerance

Cable Tension Chart*

-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

Scale: NTS	Date: 1-7-2019
Layout: ANSI B	Drafter: BH

Return to Table of Contents

U.S. Department of Transportation
Federal Highway Administration

May 15, 2020

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

In Reply Refer To:
HSST-1/CC-162

Mr. Ron Faulkenberry
Gibraltar Global, LLC.
1208 Houston Clinton Dr
Burnet TX 78611
USA

Dear Mr. Faulkenberry:

This letter is in response to your January 30, 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 CC-162 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:

- TL-3 4 Cable End Terminal

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: TL-3 4 Cable End Terminal
Type of system: End Terminal
Test Level: MASH Test Level 3 (TL3)
Testing conducted by: Applus IDIADA KARCO Engineering, LLC.
Date of request: January 30, 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 CC-162 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. Griffith

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

Enclosures

Return to Table of Contents

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter			
	Date of Request:	January 30, 2020	(•) New ( ) Resubmission
	Name:	Steven Matsusaka	
	Company:	Applus IDIADA KARCO Engineering, LLC.	
	Address:	9270 Holly Rd, Adelanto, CA 92301	
	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 Criterion - Enter from right to left starting with Test Level !-!-! !-!-!

System Type	Submission Type	Device Name / Variant	Testing Criterion	Test Level
'CC': Crash Cushions, Attenua	(•) Physical Crash Testing ( ) Engineering Analysis	TL-3 4 Cable End Terminal	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 as Submitter ☐
Company Name:	Gibraltar Global, LLC.	Same as Submitter ☐
Address:	1208 Houston Clinton Dr, Burnet TX 78611	Same as Submitter ☐
Country:	United States of America	Same as Submitter ☐

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 values are 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.

PRODUCT DESCRIPTION

Help

(•) New Hardware or Significant Modification   ( ) Modification to Existing Hardware

The Gibraltar Global TL-3 4 Cable End Terminal consists of one (1) anchor post assembly, one (1) cable release assembly, two (2) J-bolt posts, and two (2) sockets. The terminal is classified as a gating redirective end terminal designed to be used with the Gibraltar Global 4 cable MASH system. The Gibraltar Global Cable Barrier system can be installed with post spacing ranging from 7.0 ft (2.1 m) to 21.0 ft. (6.4 m), the post spacing used for this test was 7.0 ft (2.1 m) to evaluate vehicle stability and occupant compartment damage. The as-tested terminal had a total length of 27.5 ft. (8.4 m) and the complete installation length was 214.8 ft. (65.5 m). As recommended in MASH the cables were tensioned to the manufacturer's specified tension at 100°F, which was 4200 lbs.

There was one modification made during the testing of the Gibraltar Global TL-3 4 Cable End Terminal during the MASH test program. For Tests 30 and 31, the system included a LON line post installed at the end of the terminal section, 7.5 ft. (2.3 m) downstream of the second J-bolt post and 27.5 ft. (8.4 m) from the anchor post. The final system design, as used for Tests 32, 33, 34, 35, and 37b, the LON line post at the downstream end of the terminal was moved to 14.5 ft. downstream from the second J-bolt post. The overall terminal length for both versions of the system was 27.5 ft. (8.4 m). Complete details on the design modification is included in Attachment A to this submission and in the complete test reports.

CRASH TESTING

By signature below, the Engineer affiliated with the testing laboratory, agrees in support of this submission that all of the critical and relevant crash tests for this device listed above were conducted to meet the MASH test criteria. The Engineer has determined that no other crash tests are necessary to determine the device meets the MASH criteria.

Engineer Name:	Steven Matsusaka	
Engineer Signature:	Steven Matsusaka DN: cn=Steven Matsusaka, email=steven.matsusaka@idiada.com, c=US Digitally signed by Steven Matsusaka Date: 2020.01.14 19:07:40 -08'00'	
Address:	9270 Holly Rd, Adelanto, CA 92301	Same as Submitter ☒
Country:	United States of America	Same as Submitter ☒

A brief description of each crash test and its result: Help

Required Test Number	Narrative Description	Evaluation Results
3-30 (1100C)	Applus IDIADA KARCO Test No. P37410-01. An 1100C test vehicle impacting the terminal end at a nominal speed and angle of 62 mph and 0°, respectively, with the quarter point of the vehicle aligned with the centerline of the terminal. This test is primarily intended to evaluate structural adequacy, occupant risk, and vehicle trajectory. A 2013 Kia Rio 4-door sedan with a test inertial mass of 2425.0 lbs (1100.0 kg) impacted the terminal at a velocity of 61.48 mph (98.95 km/h) and and angle of 0.4°. The impact activated the cable release post and the vehicle wasallowed to penetrate the system in a controlled manner. The occupant compartment was not penetrated and deformation limits were not exceeded. The Occupant Impact Velocities (OIV) were 8.9 ft/s (2.7 m/s) and 1.0 ft/s (0.3 m/s) in the x- and y-directions, respectively. The Ridedown Accelerations were -5.6 g and -3.9 g, respectively. The Gibraltar Global TL-3 4 Cable Terminal met all of the requirements for MASH Test 3-30.	PASS
3-31 (2270P)	Applus IDIADA KARCO Test No. P37411-01. A 2270P test vehicle impacting the terminal end at a nominal speed and angle of 62 mph and 0°, respectively, with the centerline of the vehicle aligned with the centerline of the terminal. This test is primarily intended to evaluate structural adequacy, occupant risk, and vehicle trajectory. A 2012 Chevrolet Silverado 1500 4-door pickup truck with a test inertial mass of 4992.3 lbs (2264.5 kg) impacted the terminal at a velocity of 60.11 mph (96.74 km/h) and and angle of 1.1°. The impact activated the cable release post and the vehicle wasallowed to penetrate the system in a controlled manner. The occupant compartment was not penetrated and deformation limits were not exceeded. The Occupant Impact Velocities (OIV) were 2.6 ft/s (0.8 m/s) and 3.9 ft/s (1.2 m/s) in the x- and y-directions, respectively. The Ridedown Accelerations were -2.0 g and 1.7 g, respectively. The Gibraltar Global TL-3 4 Cable Terminal met all of the requirements for MASH Test 3-31.	PASS

Required Test Number	Narrative Description	Evaluation Results
3-32 (1100C)	Applus IDIADA KARCO Test No. P37403-01. An 1100C test vehicle impacting the terminal end at a nominal speed and angle of 62 mph and 5°, respectively, with the centerline of the vehicle aligned with the centerline of the terminal. This test is primarily intended to evaluate structural adequacy, occupant risk, and vehicle trajectory. A 2013 Hyundai Accent 4-door sedan with a test inertial mass of 2425.0 lbs (1100.0 kg) impacted the terminal at a velocity of 62.53 mph (100.64 km/h) and and angle of 5.3°. The impact activated the cable release post and the vehicle wasallowed to penetrate the system in a controlled manner. The occupant compartment was not penetrated and deformation limits were not exceeded. The Occupant Impact Velocities (OIV) were 8.9 ft/s (2.7 m/s) and 1.3 ft/s (0.4 m/s) in the x- and y-directions, respectively. The Ridedown Accelerations were -4.0 g and -5.0 g, respectively. The Gibraltar Global TL-3 4 Cable Terminal met all of the requirements for MASH Test 3-32.	PASS
3-33 (2270P)	Applus IDIADA KARCO Test No. P38257-01. A 2270P test vehicle impacting the terminal end at a nominal speed and angle of 62 mph and 5°, respectively, with the centerline of the vehicle aligned with the centerline of the terminal. This test is primarily intended to evaluate structural adequacy, occupant risk, and vehicle trajectory. A 2012 Chevrolet Silverado 1500 4-door pickup truck with a test inertial mass of 4946.0 lbs (2243.5 kg) impacted the terminal at a velocity of 61.60 mph (99.14 km/h) and and angle of 5.2°. The impact activated the cable release post and the vehicle wasallowed to penetrate the system in a controlled manner. The occupant compartment was not penetrated and deformation limits were not exceeded. The Occupant Impact Velocities (OIV) were 0.3 ft/s (0.1 m/s) and 3.0 ft/s (0.9 m/s) in the x- and y-directions, respectively. The Ridedown Accelerations were -1.4 g and 0.8 g, respectively. The Gibraltar Global TL-3 4 Cable Terminal met all of the requirements for MASH Test 3-33.	PASS

3-34 (1100C)	Applus IDIADA KARCO Test No. P38333-01. An 1100C test vehicle impacting the terminal at a nominal speed and angle of 62 mph and 15°, respectively, with the corner of the vehicle bumper aligned with the Critical Impact Point (CIP) of the Length of Need (LON) of the terminal. This test is primarily intended to evaluate structural adequacy, occupant risk, and vehicle trajectory. A 2013 Kia Rio 4-door sedan with a test inertial mass of 2432.8 lbs (1103.5 kg) impacted the terminal at a velocity of 62.33 mph (100.31 km/h) and and angle of 15.6°. The system contained and redirected the vehicle within the exit box and with a Working Width of 3.7 ft. (1.1 m). The occupant compartment was not penetrated and deformation limits were not exceeded. The Occupant Impact Velocities (OIV) were 10.8 ft/s (3.3 m/s) and 12.1 ft/s (3.7 m/s) in the x- and y-directions, respectively. The Ridedown Accelerations were -6.1 g and -8.0 g, respectively. The Gibraltar Global TL-3 4 Cable Terminal met all of the requirements for MASH Test 3-34.	PASS
3-35 (2270P)	Applus IDIADA KARCO Test No. P38194-01. A 2270P test vehicle impacting the terminal at a nominal speed and angle of 62 mph and 25°, respectively, with the corner of the vehicle bumper aligned with the beginning of the Length of Need (LON) of the terminal. This test is primarily intended to evaluate structural adequacy, occupant risk, and vehicle trajectory. A 2012 Chevrolet Silverado 1500 4-door pickup truck with a test inertial mass of 5008.8 lbs (2272.0 kg) impacted the terminal at a velocity of 63.23 mph (101.76 km/h) and and angle of 25.2°. The system contained and redirected the vehicle within the exit box and with a Working Width of 9.7 ft. (3.0 m). The occupant compartment was not penetrated and deformation limits were not exceeded. The Occupant Impact Velocities (OIV) were 3.9 ft/s (1.2 m/s) and 10.5 ft/s (3.2 m/s) in the x- and y-directions, respectively. The Ridedown Accelerations were -3.7 g and 4.4 g, respectively. The Gibraltar Global TL-3 4 Cable Terminal met all of the requirements for MASH Test 3-35.	PASS

3-36 (2270P)	MASH Test Designation 3-36. A 2270P test vehicle impacting the terminal at a nominal impact speed and angle of 62 mph and 25°, respectively,with the corner of the vehicle bumper aligned with the Critical Impact Point (CIP) with respect to the transition to a stiff barrier or backup structure. This test Is primarily intended to evaluate the performance of the terminal when connected to astiff barrier or a backup structure. Asa cable barrier terminal, the Gibraltar Global TL-3 4 Cable Terminal is not designed to be transition into astiff barrier or backup structure and therefore Test 36 is not relevant and was not conducted.	Non-Relevant Test, not conducted
3-37 (2270P)	Applus IDIADA KARCO Test No. P38236-01. An 1100C test vehicle impacting the terminal at a nominal speed and angle of 62 mph and 25°, respectively, with the corner of the vehicle bumper aligned with the Critical Impact Point (CIP) of the terminal for reverse direction impacts. This test is primarily intended to evaluate structural adequacy, occupant risk, and vehicle trajectory in a reverse direction impact. A 2012 KiaRio 4-door sedan with a test inertial mass of 2448.2 lbs (1110.5 kg) impacted the terminal at a velocity of 62.53 mph (100.63 km/h) and and angle of 24.9°. Upon impact, cables released and allowed the vehicle to gate through the system in a controlled manner. The occupant compartment was not penetrated and deformation limits were not exceeded. The Occupant Impact Velocities (OIV) were 23.3 ft/s (7.1 m/s) and 19.7 ft/s (6.0 m/s) in the x- and y-directions, respectively. The Ridedown Accelerations were -16.0 g and 12.9 g, respectively. The Gibraltar Global TL-3 4 Cable Terminal met all of the requirements for MASH Test 3-37b.	PASS
3-38 (1500A)	MASH Test Designation 3-38. A 1500A test vehicle impacting the terminal end-on at a nominal impact speed and angle of 62 mph and 0°, respectively, with the centerline of the vehicle aligned with the centerline of the terminal. This test Is primarily intended to evaluate the performance of astaged attenuator/ terminal when Impacted by a mid-size vehicle. The Gibraltar Global TL-3 4 Cable Terminal is not astaged device, because the force required to move the Impact head down the rail does not change. Therefore, Test 38 is not relevant and was not conducted.	Non-Relevant Test, not conducted

3-40 (1100C)	Test for non-redirective crash cushions, not applicable for terminals.	Non-Relevant Test, not conducted
3-41 (2270P)	Test for non-redirective crash cushions, not applicable for terminals.	Non-Relevant Test, not conducted
3-42 (1100C)	Test for non-redirective crash cushions, not applicable for terminals.	Non-Relevant Test, not conducted
3-43 (2270P)	Test for non-redirective crash cushions, not applicable for terminals.	Non-Relevant Test, not conducted
3-44 (2270P)	Test for non-redirective crash cushions, not applicable for terminals.	Non-Relevant Test, not conducted
3-45 (1500A)	Test for non-redirective crash cushions, not applicable for terminals.	Non-Relevant Test, not conducted

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:	Applus IDIADA KARCO Engineering, LLC.	
Laboratory Signature:	Steven Matsusaka DN: cn=Steven Matsusaka, email=steven.matsusaka@idiada.com, c=US Digitally signed by Steven Matsusaka Date: 2020.01.14 19:07:54 -08'00'	
Address:	9270 Holly Rd, Adelanto, CA 92301	Same as Submitter ☒
Country:	United States of America	Same as Submitter ☒
Accreditation Certificate Number and Dates of current Accreditation period :	TL-371: July 2019 - July 2022	

Submitter Signature*: Steven Matsusaka Digitally signed by Steven Matsusaka DN: cn=Steven Matsusaka, email=steven.matsusaka@idiada.com, c=US Date: 2020.01.14 19:07:59 -08'00'

Submit Form

ATTACHMENTS

Attach to this form:

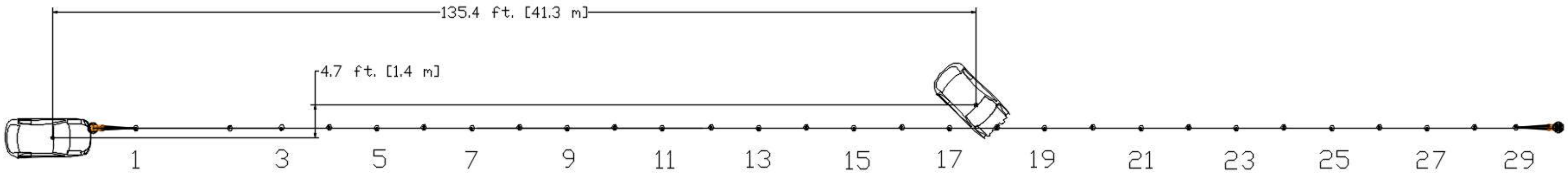
1) Additional disclosures of related financial interest as indicated above.
2) A copy of the full test report, video, and a Test Data Summary Sheet for each test conducted in support of this request.
3) A drawing or drawings of the device(s) that conform to the Task Force-13 Drawing Specifications [Hardware 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 2016 Test 3-30 Summary

0.000 s | 0.100 s | 0.200 s | 0.300 s | 0.500 s



GENERAL INFORMATION

Test Agency	Applus IDIADA KARCO
Test No.	P37410-01
Test Designation	3-30
Test Date	1/29/18

TEST ARTICLE

Name / Model	TL-3 4 Cable Terminal
Type	End Terminal
Installation Length	214.8 ft. (65.5 m)
Terminal Length	27.5 ft. (8.4 m)
Road Surface	Compacted Soil

TEST VEHICLE

Type / Designation	1100C
Year, Make, and Model	2013 Kia Rio
Curb Mass	2,508.8 lbs (1,138.0 kg)
Test Inertial Mass	2,425.0 lbs (1,100.0 kg)
Gross Static Mass	2,600.3 lbs (1,179.5 kg)

Impact Conditions

Impact Velocity	61.48 mph (98.95 km/h)
Impact Angle	0.4°
Location / Orientation	Offset 16.3 in. (414 mm)
Kinetic Energy	306.4 kip-ft (415.5 kJ)

Exit Conditions

Exit Velocity	Vehicle did not exit
Exit Angle	N/A
Final Vehicle Position	135.4 ft. (41.3 m) Downstream 4.7 ft. (1.4 m) Left
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	4.0 °
Maximum Pitch Angle	1.7 °
Maximum Yaw Angle	17.8 °

Occupant Risk

Longitudinal OIV	8.9 ft/s (2.7 m/s)
Lateral OIV	1.0 ft/s (0.3 m/s)
Longitudinal RA	-5.6 g
Lateral RA	-3.9 g
THIV	8.9 ft/s (2.7 m/s)
PHD	5.8 g
ASI	0.21

Test Article Deflections

Static	N/A
Dynamic	5.6 ft. (1.7 m)
Working Width	5.6 ft. (1.7 m)
Debris Field	129.4 ft. (39.4 m) Downstream 5.3 ft. (1.6 m) Left

Vehicle Damage

Vehicle Damage Scale	12-FD-3
CDC	12FDEW2
Maximum Intrusion	0.2 in. (5 mm)

Figure 4 Summary of Test 3-30

MASH 2016 Test 3-31 Summary

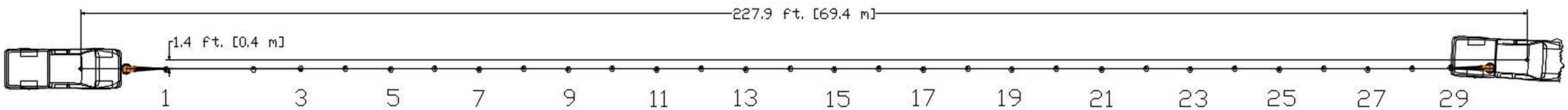
0.000 s

0.100 s

0.200 s

0.300 s

0.500 s



GENERAL INFORMATION	
Test Agency	Applus IDIADA KARCO
Test No.	P37411-01
Test Designation	3-31
Test Date	1/29/18
TEST ARTICLE	
Name / Model	TL-3 4 Cable Terminal
Type	End Terminal
Installation Length	214.8 ft. (65.5 m)
Terminal Length	27.5 ft. (8.4 m)
Road Surface	Compacted Soil
TEST VEHICLE	
Type / Designation	2270P
Year, Make, and Model	2012 Chevrolet Silverado 1500
Curb Mass	4,898.6 lbs (2,222.0 kg)
Test Inertial Mass	4,992.3 lbs (2,264.5 kg)
Gross Static Mass	4,992.3 lbs (2,264.5 kg)

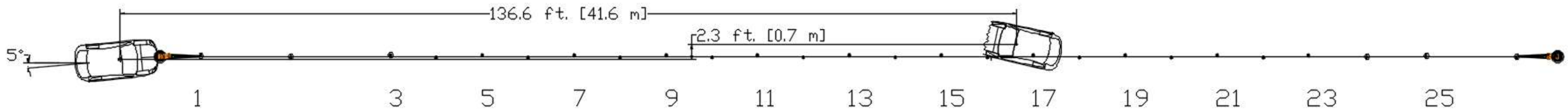
Impact Conditions	
Impact Velocity	60.11 mph (96.74 km/h)
Impact Angle	1.1°
Location / Orientation	1.4 in (36 mm) Left
Kinetic Energy	603.0 kip-ft (817.6 kJ)
Exit Conditions	
Exit Velocity	Vehicle did not exit
Exit Angle	N/A
Final Vehicle Position	227.9 ft. (69.5 m) Left 1.4 ft. (0.4 m) Downstream
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	2.3 °
Maximum Pitch Angle	-2.5 °
Maximum Yaw Angle	4.4 °

Occupant Risk	
Longitudinal OIV	2.6 ft/s (0.8 m/s)
Lateral OIV	3.9 ft/s (1.2 m/s)
Longitudinal RA	-2.0 g
Lateral RA	1.7 g
THIV	4.9 ft/s (1.5 m/s)
PHD	2.2 g
ASI	0.1
Test Article Deflections	
Static	N/A
Dynamic	3.3 ft. (1.0 m)
Working Width	3.3 ft. (1.0 m)
Debris Field Lateral	6.7 ft. (2.0 m)
Vehicle Damage	
Vehicle Damage Scale	12-FD-2
CDC	12FDEW2
Maximum Intrusion	0.3 in. (8 mm)

Figure 4 Summary of Test 3-31

MASH 2016 Test 3-32 Summary

0.000 s | 0.120 s | 0.240 s | 0.360 s | 0.540 s



GENERAL INFORMATION	
Test Agency	Applus IDIADA KARCO
Test No.	P37403-01
Test Designation	3-32
Test Date	2/12/18
TEST ARTICLE	
Name / Model	TL-3 4 Cable Terminal
Type	End Terminal
Installation Length	213.0 ft. (64.9 m)
Terminal Length	27.5 ft. (8.4 m)
Road Surface	Compacted Soil
TEST VEHICLE	
Type / Designation	1100C
Year, Make, and Model	2013 Hyundai Accent
Curb Mass	2,489.0 lbs (1,129.0 kg)
Test Inertial Mass	2,425.0 lbs (1,100.0 kg)
Gross Static Mass	2,592.6 lbs (1,176.0 kg)

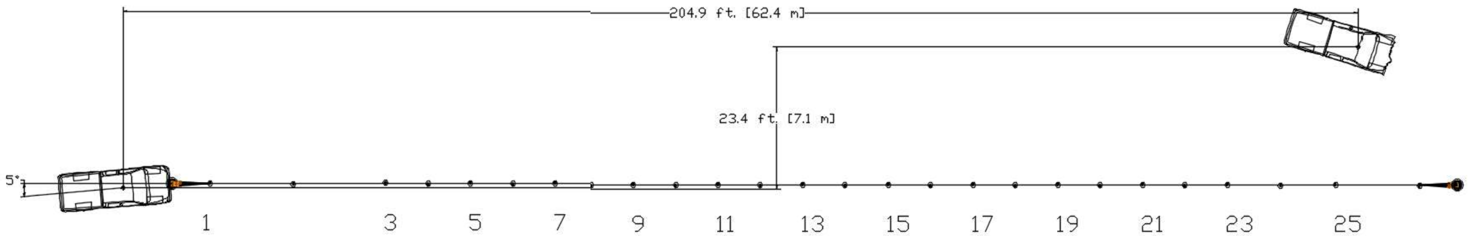
Impact Conditions	
Impact Velocity	62.53 mph (100.64 km/h)
Impact Angle	5.3°
Location / Orientation	1.5 in. (38 mm) Right of CL
Kinetic Energy	317.0 kip-ft (429.8 kJ)
Exit Conditions	
Exit Velocity	Vehicle did not exit
Exit Angle	N/A
Final Vehicle Position	136.6 ft. (41.6 m) Downstream 2.3 ft. (0.7 m) Left
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	-3.6 °
Maximum Pitch Angle	6.3 °
Maximum Yaw Angle	-12.9 °

Occupant Risk	
Longitudinal OIV	8.9 ft/s (2.7 m/s)
Lateral OIV	1.3 ft/s (0.4 m/s)
Longitudinal RA	-4.0 g
Lateral RA	-5.0 g
THIV	8.9 ft/s (2.7 m/s)
PHD	6.3 g
ASI	0.23
Test Article Deflections	
Static	N/A
Dynamic	5.6 ft. (1.7 m)
Working Width	11.1 ft. (3.4 m)
Debris Field	119.1 ft. (36.3 m) Downstream 14.0 ft. (4.3 m) Left
Vehicle Damage	
Vehicle Damage Scale	12-FR-4
CDC	12FZEW2
Maximum Intrusion	Negligible

Figure 3 Summary of Test 3-32

MASH 2016 Test 3-33 Summary

0.000 s | 0.100 s | 0.200 s | 0.300 s | 0.500 s



GENERAL INFORMATION

Test Agency	IDIADA KARCO Engineering
Test No.	P38257-01
Test Designation	3-33
Test Date	8/31/18

TEST ARTICLE

Name / Model	TL-3 4 Cable Terminal
Type	End Terminal
Installation Length	213.0 ft. (64.9 m)
Terminal Length	27.5 ft. (8.4 m)
Road Surface	Compacted Soil

TEST VEHICLE

Type / Designation	2270P
Year, Make, and Model	2012 Chevrolet Silverado 1500
Curb Mass	5,060.6 lbs (2,295.5 kg)
Test Inertial Mass	4,946.0 lbs (2,243.5 kg)
Gross Static Mass	4,946.0 lbs (2,243.5 kg)

Impact Conditions

Impact Velocity	61.60 mph (99.14 km/h)
Impact Angle	5.2°
Location / Orientation	0.75 in. (19 mm) left of CL
Kinetic Energy	615.8 kip-ft (835.0 kJ)

Exit Conditions

Exit Velocity	59.36 mph (95.53 km/h)
Exit Angle	3.4°
Final Vehicle Position	204.9 ft. (62.5 m) Downstream 23.4 ft. (7.1 m) Left
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	-0.7 °
Maximum Pitch Angle	1.9 °
Maximum Yaw Angle	-3.3 °

Occupant Risk

Longitudinal OIV	0.3 ft/s (0.1 m/s)
Lateral OIV	3.0 ft/s (0.9 m/s)
Longitudinal RA	-1.4 g
Lateral RA	0.8 g
THIV	3.6 ft/s (1.1 m/s)
PHD	1.6 g
ASI	0.09

Test Article Deflections

Static	N/A
Dynamic	3.3 ft. (1.0 m)
Working Width	3.3 ft. (1.0 m)
Debris Field	64.3 ft. (19.6 m) Downstream 7.9 ft. (2.4 m) Left

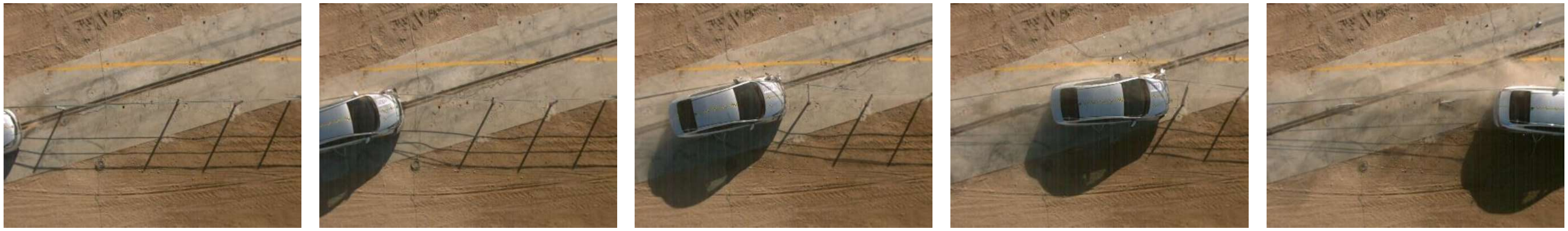
Vehicle Damage

Vehicle Damage Scale	12-FD-2*
CDC	12FDLW1*
Maximum Intrusion	Negligible*

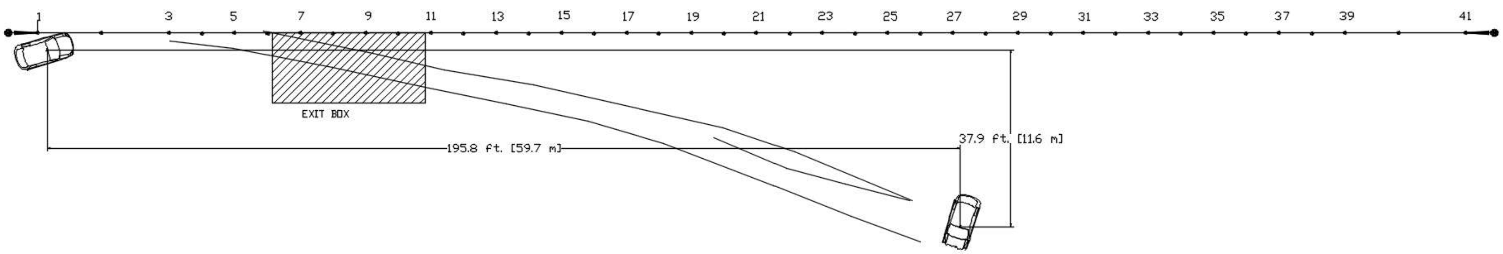
* Before secondary impact

Figure 4 Summary of Test 3-33

MASH 2016 Test 3-34 Summary



0.000 s | 0.100 s | 0.200 s | 0.300 s | 0.500 s



GENERAL INFORMATION	
Test Agency	Applus IDIADA KARCO
Test No.	P38333-01
Test Designation	3-34
Test Date	11/20/18
TEST ARTICLE	
Name / Model	TL-3 4 Cable Terminal
Type	End Terminal
Installation Length	318.3 ft. (97.0 m)
Terminal Length	27.5 ft. (8.4 m)
Road Surface	Compacted soil
TEST VEHICLE	
Type / Designation	1100C
Year, Make, and Model	2013 Kia Rio
Curb Mass	2,554.0 lbs (1,158.5 kg)
Test Inertial Mass	2,432.8 lbs (1,103.5 kg)
Gross Static Mass	2,637.8 lbs (1,196.5 kg)

Impact Conditions	
Impact Velocity	62.33 mph (100.31 km/h)
Impact Angle	15.6°
Location / Orientation	3.4 in. (86 mm) from midspan
Impact Severity	22.8 kip-ft (31.0 kJ)
Exit Conditions	
Exit Velocity	48.09 mph (77.39 km/h)
Exit Angle	4.5°
Final Vehicle Position	195.8 ft. (59.7 m) Downstream 37.9 ft. (11.6 m) Right
Exit Box Criteria Met	Yes
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	2.9 °
Maximum Pitch Angle	8.9 °
Maximum Yaw Angle	-19.5 °

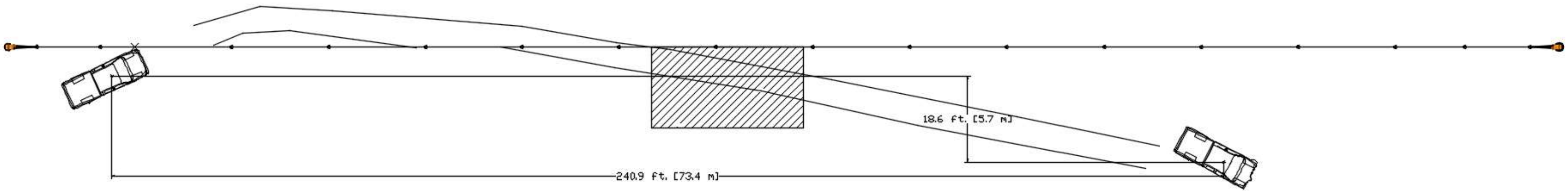
Occupant Risk	
Longitudinal OIV	10.8 ft/s (3.3 m/s)
Lateral OIV	12.1 ft/s (3.7 m/s)
Longitudinal RA	-6.1 g
Lateral RA	-8.0 g
THIV	18.0 ft/s (5.5 m/s)
PHD	9.8 g
ASI	0.41
Test Article Deflections	
Static	N/A
Dynamic	3.2 ft. (1.0 m)
Working Width	3.7 ft. (1.1 m)
Debris Field	100.1 ft. (30.5 m) Downstream 24.7 ft. (7.5 m) Lateral
Vehicle Damage	
Vehicle Damage Scale	11-LFQ-4
CDC	11LYEW3
Maximum Intrusion	0.6 in. (15 mm)

Figure 3 Summary of Test 3-34

Return to Table of Contents

MASH 2016 Test 3-35 Summary

0.000 s | 0.400 s | 0.800 s | 1.200 s | 1.600 s



GENERAL INFORMATION

Test Agency……………..	Applus IDIADA KARCO
Test No………..	P38194-01
Test Designation…………	3-35
Test Date…………………	6/29/18

TEST ARTICLE

Name / Model…………….	TL-3 4 Cable Terminal
Type………………………..	End Terminal
Installation Length……….	335.7 ft. (102.3 m)
Terminal Length………….	27.5 ft. (8.4 m)
Road Surface…………….	Concrete and compacted soil

TEST VEHICLE

Type / Designation……….	2270P
Year, Make, and Model….	2012 Chevrolet Silverado 1500
Curb Mass………………..	5,049.6 lbs (2,290.5 kg)
Test Inertial Mass………..	5,008.8 lbs (2,272.0 kg)
Gross Static Mass………	5,008.8 lbs (2,272.0 kg)

Impact Conditions

Impact Velocity…………….	63.23 mph (101.76 km/h)
Impact Angle…………………	25.2°
Location / Orientation………	LON Point
Impact Severity………………	121.4 kip-ft (164.5 kJ)

Exit Conditions

Exit Velocity…………………	Out of Camera View
Exit Angle……………………	N/A
Final Vehicle Position………	240.9 ft. (73.4 m) Downstream 18.6 ft. (5.7 m) Right
Exit Box Criteria Met………	Yes
Vehicle Snagging……………	None
Vehicle Pocketing………….	None
Vehicle Stability…………….	Satisfactory
Maximum Roll Angle……….	11.3 °
Maximum Pitch Angle………	3.9 °
Maximum Yaw Angle……….	24.9 °

Occupant Risk

Longitudinal OIV……………	3.9 ft/s (1.2 m/s)
Lateral OIV…………………	10.5 ft/s (3.2 m/s)
Longitudinal RA……………	-3.7 g
Lateral RA…………………	4.4 g
THIV…………………………	10.8 ft/s (3.3 m/s)
PHD…………………………	4.4 g
ASI…………………………	0.42

Test Article Deflections

Static…………………………	3.4 ft. (1.0 m)
Dynamic……………………	9.7 ft. (3.0 m)
Working Width………………	9.7 ft. (3.0 m)
Debris Field…………………	172.8 ft. (52.7 m) Downstream 37.0 ft. (11.3 m) Field Side

Vehicle Damage

Vehicle Damage Scale…….	11-LFQ-3
CDC…………………………	11FRMN2
Maximum Intrusion…………	Negligible

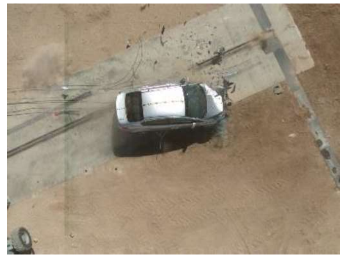
Figure 4 Summary of Test 3-35

Return to Table of Contents

MASH 2016 Test 3-37b Summary

0.000 s

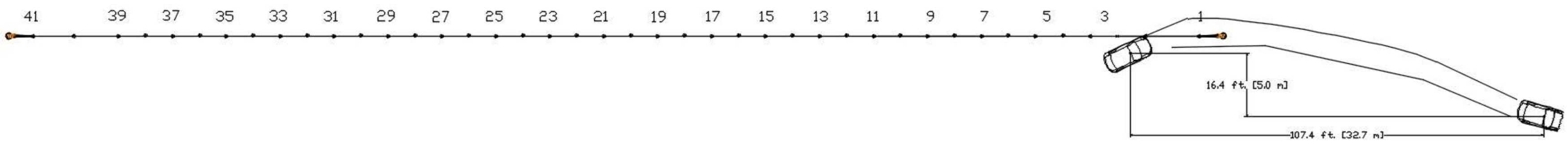
0.100 s



0.300 s

0.500 s

0.700 s

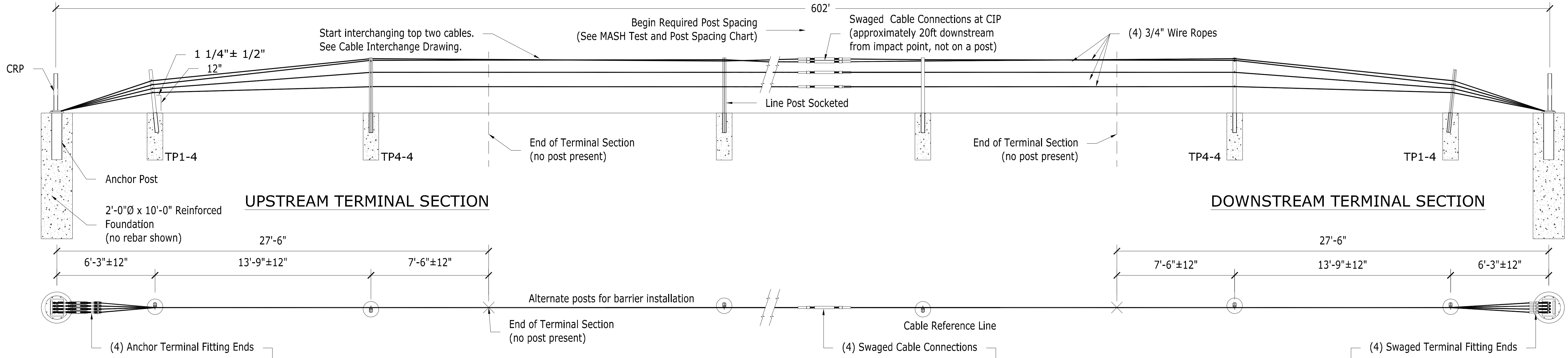


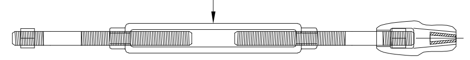
GENERAL INFORMATION	
Test Agency	Applus IDIADA KARCO
Test No.	P38236-01
Test Designation	3-37b
Test Date	9/17/18
TEST ARTICLE	
Name / Model	TL-3 4 Cable Terminal
Type	End Terminal
Installation Length	314.8 ft. (96 m)
Terminal Length	27.5 ft. (8.4 m)
Road Surface	Compacted soil
TEST VEHICLE	
Type / Designation	1100C
Year, Make, and Model	2012 Kia Rio
Curb Mass	2,417.3 lbs (1,096.5 kg)
Test Inertial Mass	2,448.2 lbs (1,110.5 kg)
Gross Static Mass	2,613.5 lbs (1,185.5 kg)

Impact Conditions	
Impact Velocity	62.53 mph (100.63 km/h)
Impact Angle	24.9°
Location / Orientation	Terminal Post 2
Impact Severity	56.7 kip-ft (76.9 kJ)
Exit Conditions	
Exit Velocity	32.06 mph (51.60 km/h)
Exit Angle	3.2°
Final Vehicle Position	107.4 ft. (32.7 m) Downstream 16.4 ft. (5.0 m) Right
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	-7.1 °
Maximum Pitch Angle	3.7 °
Maximum Yaw Angle	-62.6 °

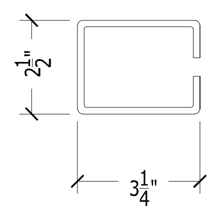
Occupant Risk	
Longitudinal OIV	23.3 ft/s (7.1 m/s)
Lateral OIV	19.7 ft/s (6.0 m/s)
Longitudinal RA	-16.0 g
Lateral RA	12.9 g
THIV	39.7 ft/s (12.1 m/s)
PHD	20.1 g
ASI	1.39
Test Article Deflections	
Static	N/A
Dynamic	4.3 ft. (1.3 m)
Working Width	16.0 ft. (4.9 m)
Debris Field	146.1 ft. (44.5 m) Downstream 32.8 ft. (10 m) Lateral
Vehicle Damage	
Vehicle Damage Scale	01-LFQ-4
CDC	01FDEW3
Maximum Intrusion	0.7 in. (18 mm)

Figure 4 Summary of Test 3-37b

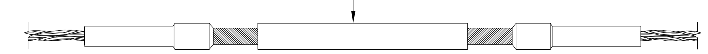




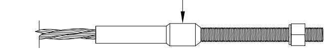
1" Anchor Terminal Fitting



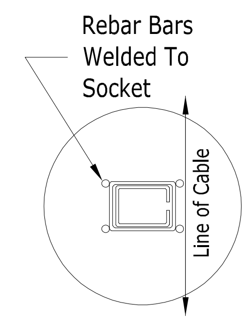
C Section Post



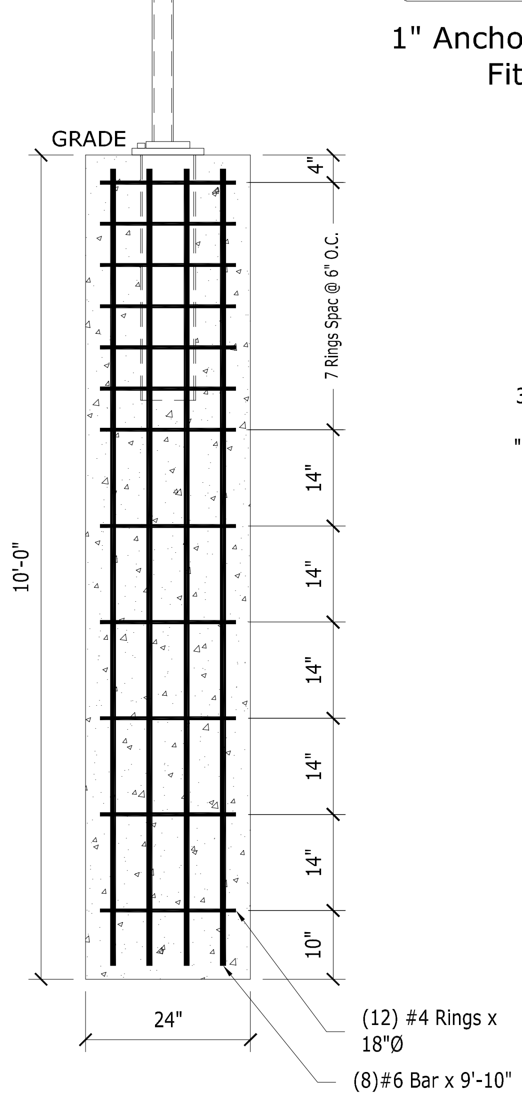
1" Swaged Cable Connection



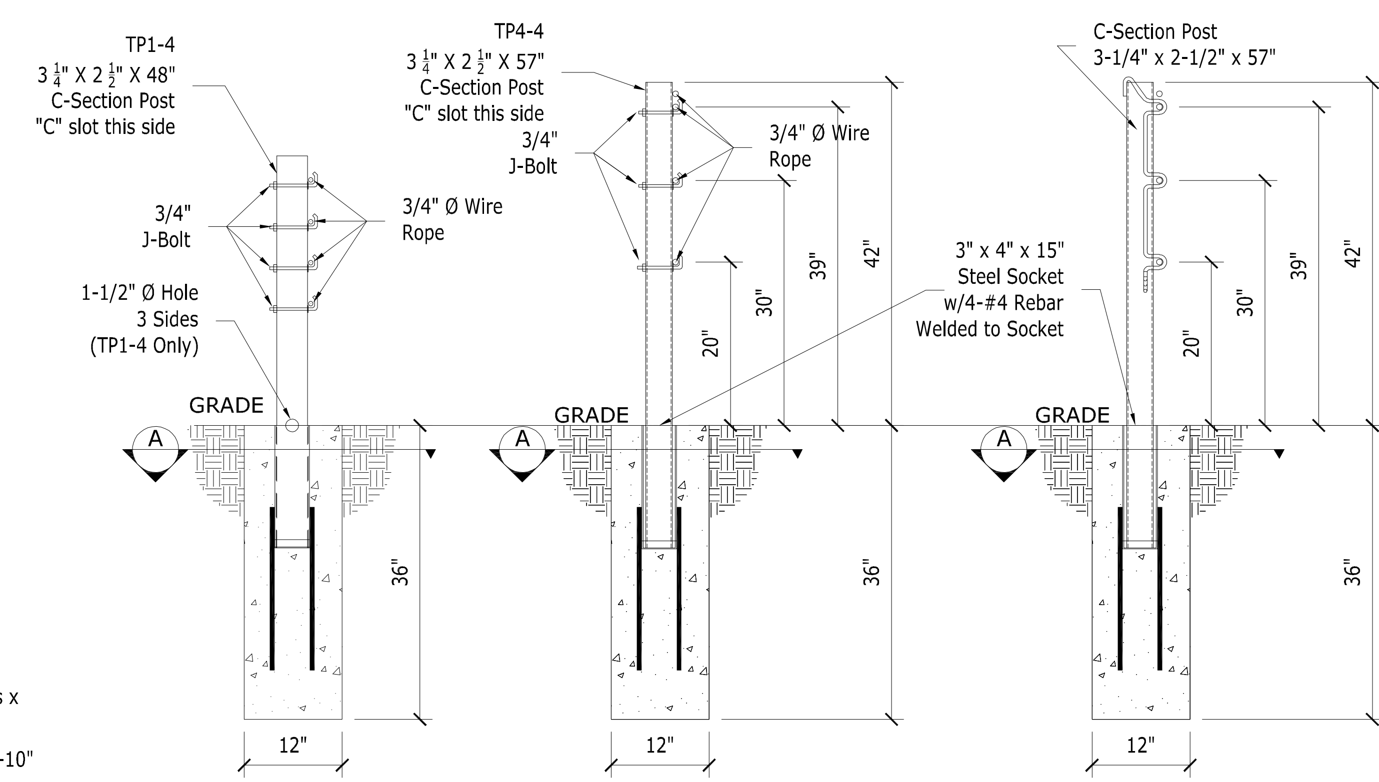
1" RH Swaged Terminal Fitting



Section A



Cable Release & Anchor Post



Terminal Post
(Welded Rebar Socket)

Terminal Post
(Welded Rebar Socket)

Line Post
(Welded Rebar Socket)

TL-4 4 Cable MASH Test and Post Spacing Chart

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

*±6" post spacing tolerance
**All tests are impacted near the midpoint of the installation at a 25° angle, except the 4-12 test, which is impacted at 15°.

Cable Tension Chart*

-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%

Return to Table of Contents

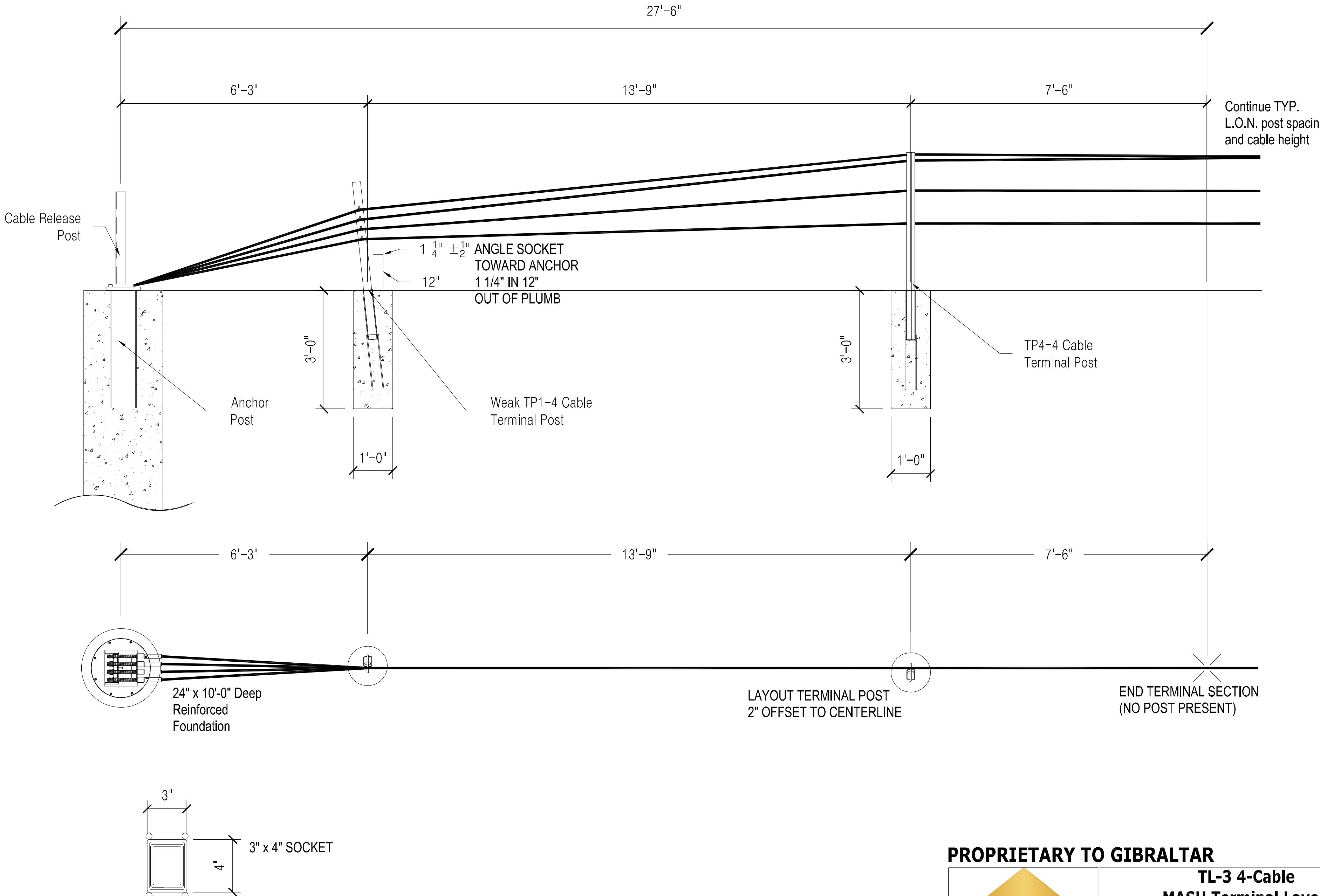
MASH 4 Cable Tests
PROPRIETARY TO GIBRALTAR

TL-4 4 Cable System Layout

Gibraltar Cable Barrier Systems

Scale: NTS	Date: 12-19-18
Layout: ANSI B	Drafter: JP

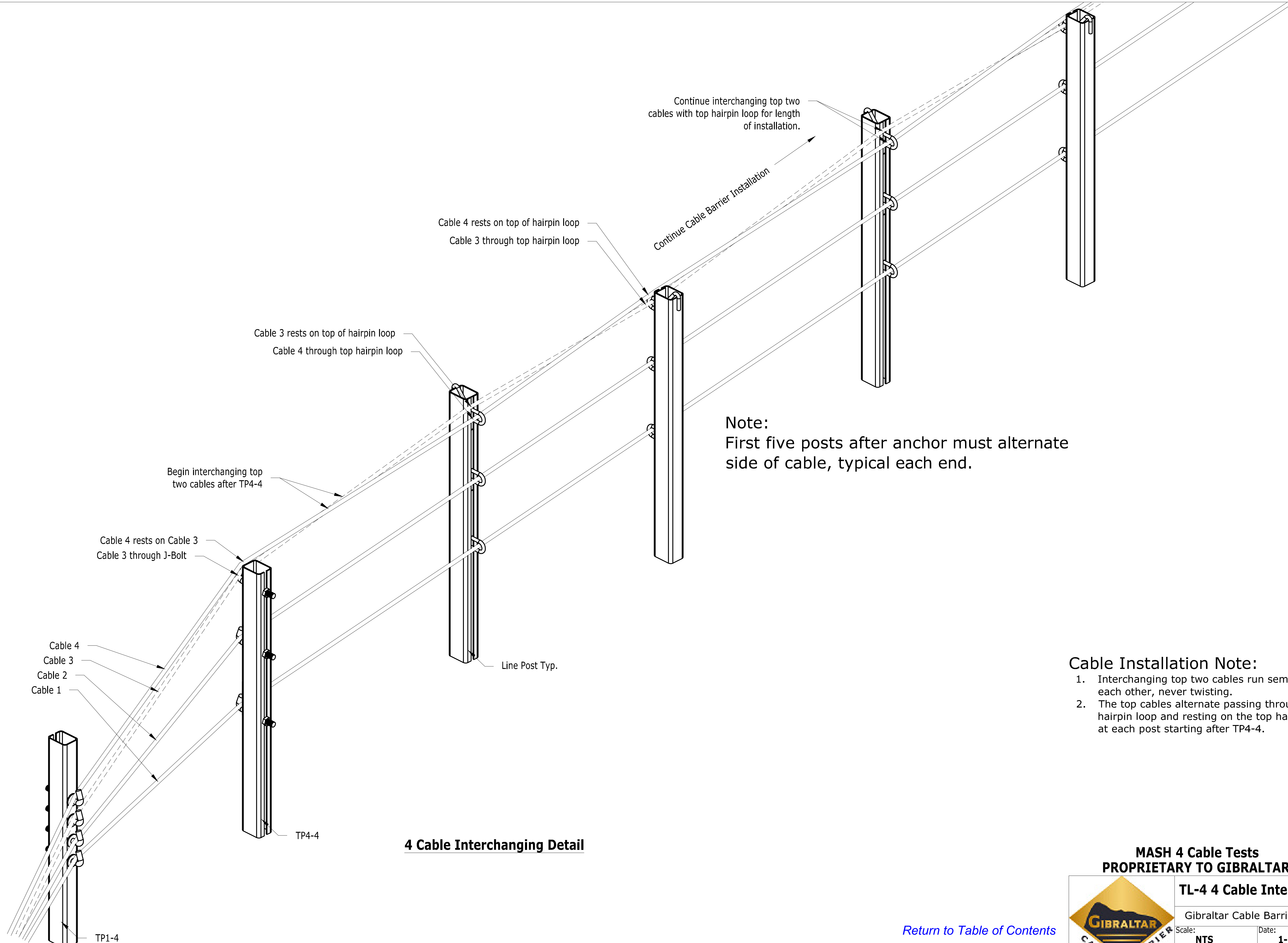
Rev Date:	Approver:
1-23-19	BH



PROPRIETARY TO GIBRALTAR

Return to Table of Contents

TL-3 4-Cable MASH Terminal Layout	
Gibraltar Cable Barrier Systems	
Scale: **NTS**	Date: **1-23-19**
Layout: **ANSI B**	Drafter: **BH**



Note:
First five posts after anchor must alternate side of cable, typical each end.

4 Cable Interchanging Detail

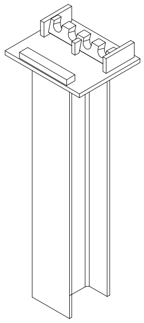
Cable Installation Note:

1. Interchanging top two cables run semi-parallel to each other, never twisting.
2. The top cables alternate passing through the top hairpin loop and resting on the top hairpin loop at each post starting after TP4-4.

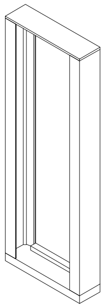
MASH 4 Cable Tests
PROPRIETARY TO GIBRALTAR

Return to Table of Contents

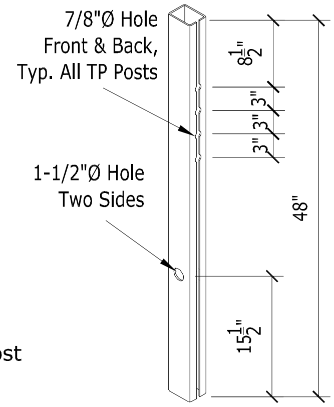
TL-4 4 Cable Interchanging	
Gibraltar Cable Barrier Systems	
Scale: **NTS**	Date: **1-2-19**
Layout: **ANSI B**	Drafter: **JP**



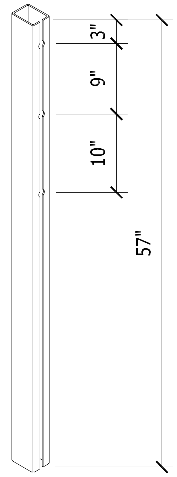
Anchor Post



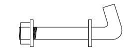
Cable Release Post



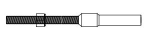
TP1-4
Terminal Post
No. 1/Weak



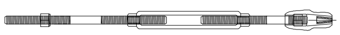
TP4-4
Terminal Post



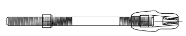
J-BLT
J-Bolt



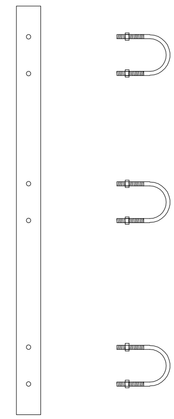
RH STUD ATF ASSY
Anchor Terminal Fitting RH Stud



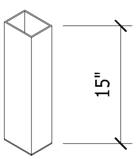
ATF
Anchor Terminal Fitting



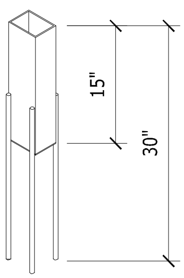
ATF-END
Anchor Terminal Fitting End



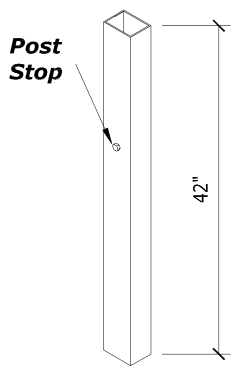
U-Bolt Lock-Plate Assembly



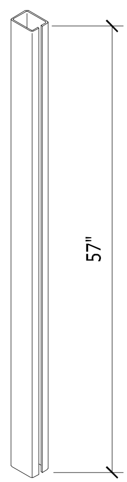
Tube Socket
(Steel or Plastic)



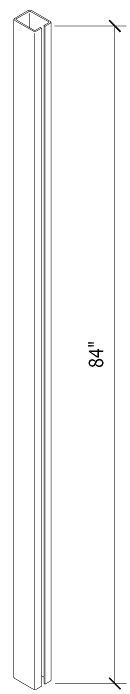
SOCK-S
Short Rebar Socket



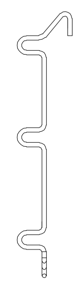
TUBE-D
Driven Socket



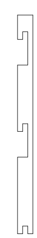
4-LNP-S
Line Post/Socketed



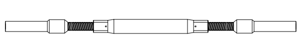
4-LNP-D
Line Post/Driven



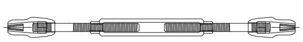
4-HPIN ALUM



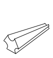
4-LOCK
TL4 Lockplate



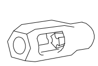
RH/LH SWAGE ASSY



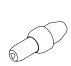
CSTB
Cable Splice Turnbuckle



WEDGE
W-1 Wedge



ACORN
Acorn w/ Wedge



TORP
Longitudinal Section ONLY
Torpedo Cable Splice

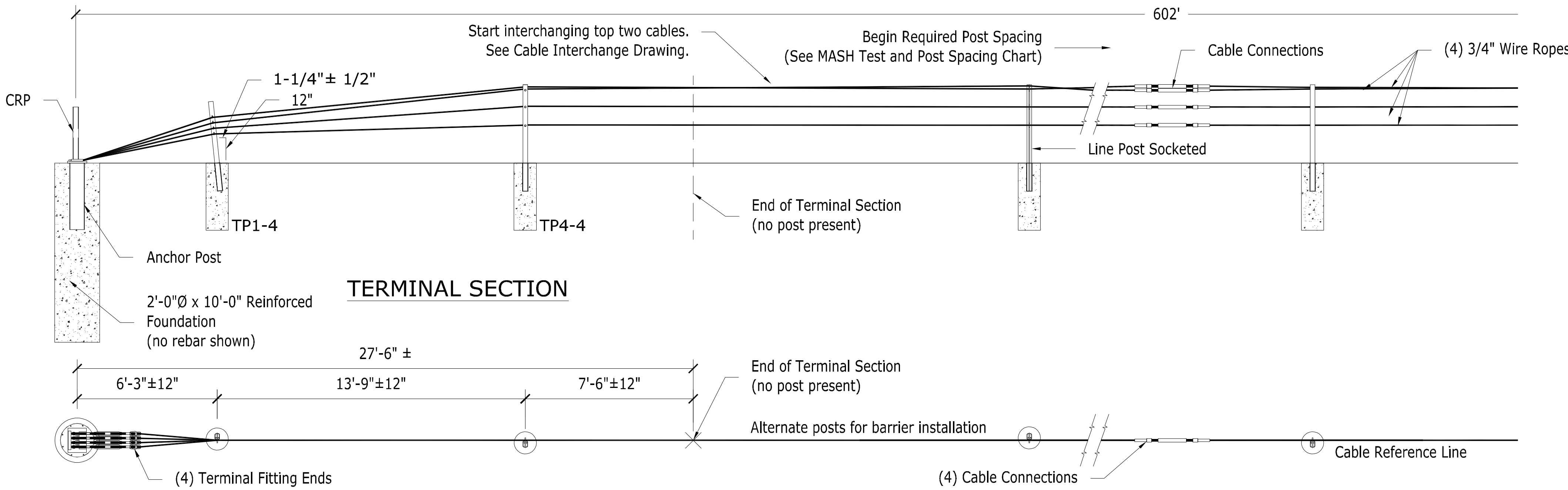
Return to Table of Contents

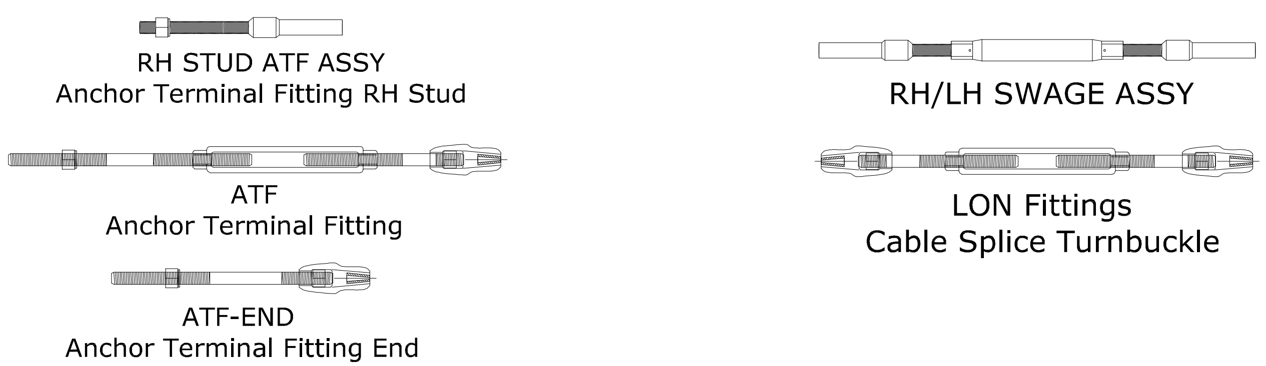
PROPRIETARY TO GIBRALTAR

TL4 MASH System Parts

Gibraltar Cable Barrier Systems

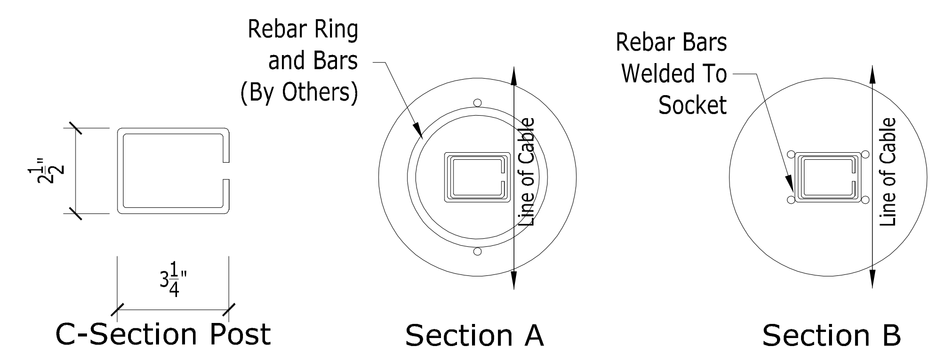
Scale: **NTS**	Date: **12/19/18**
Layout: **ANSI B**	Drafter: **BH**

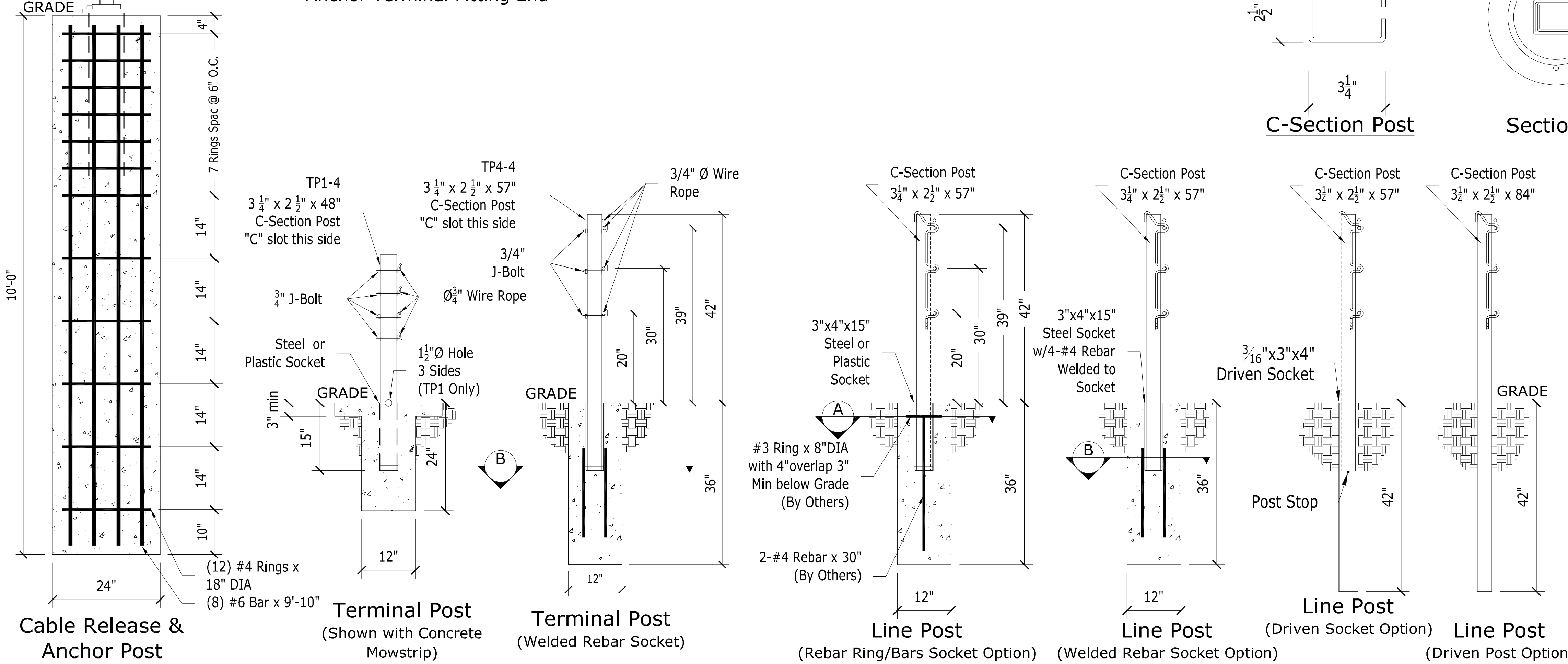




GENERAL NOTES:

1. For additional information contact Gibraltar, Inc. at 1-833-715-0810 or see the manufacturer's product manual.
2. All concrete shall be per specification; minimum 2500 PSI.
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 Spacing 18' on 4:1)
4. The Cable Barrier System is accepted by the FHWA Test Level - 4.
5. See the specification for delineation.
6. Rock Clause: Where solid rock is encountered:
   - 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.
7. The Gibraltar cable barrier system shall be installed in standard compacted soil. Soil must be well drained.
8. All non-welded rebar by others.
9. Minimum recommended line post foundation.
   - 9.A. Without mowstrip, 36" Deep x 12" diameter foundations with #3 rebar ring x 8" diameter with two #4 rebar vertical bars 30" long or 30" welded rebar socket.
   - 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 socket.
   - 9.C. With 3" minimum depth concrete mowstrip, 24" deep x 12" diameter foundations. (No rebar required).
   - 9.D. Direct drive driven post and driven socket 42" deep.





TL-4 4 Cable MASH Test and Post Spacing Chart	
MASH TEST	Line Post Spacing
3-10	7'-0"
3-11	7'-0"
3-11	21'-0"
4-12	21'-0"

*±6" post spacing tolerance

Cable Tension Chart*	
-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

Scale: NTS	Date: 1-7-2019
Layout: ANSI B	Drafter: BH

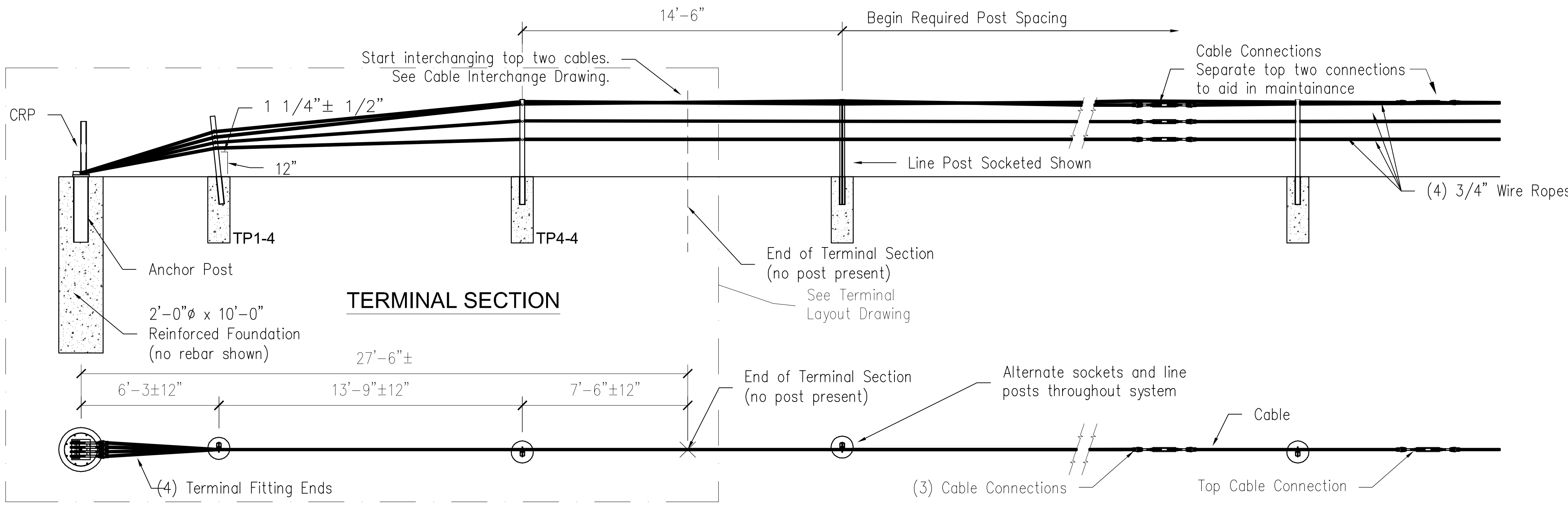
Return to Table of Contents

MASH 2016 TL4 CABLE BARRIER SYSTEM

SYSTEM DRAWINGS

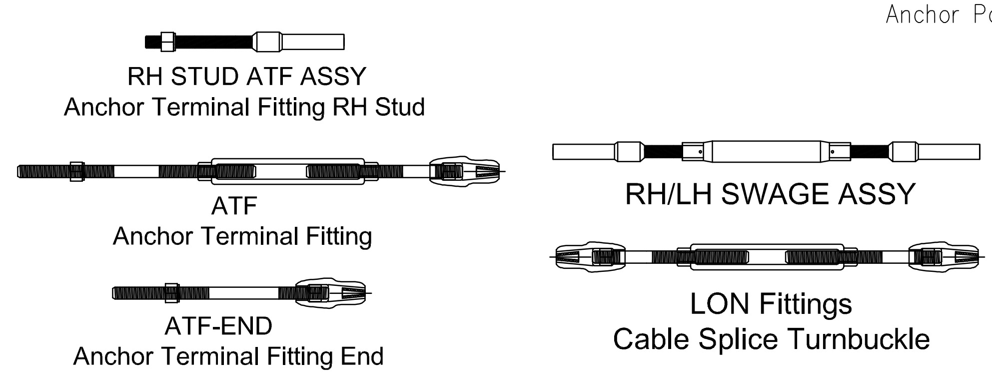
GIBRALTAR CABLE BARRIER SYSTEM
1208 HOUSTON CLINTON DR.
BURNET, TEXAS 78611
+1(512) 715-0808
WWW.GIBRALTARGLOBAL.COM

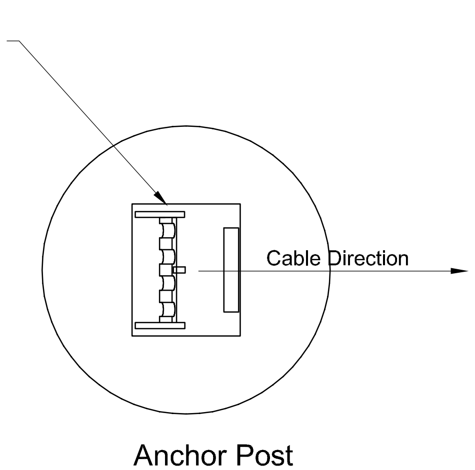
Updated: February 2022

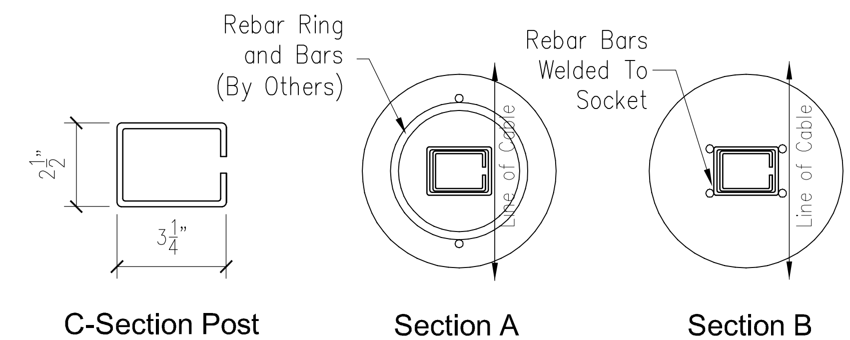


GENERAL NOTES:

1. For additional information contact Gibraltar, Inc. at 1-833-715-0810 or see the manufacturer's product manual.
2. All concrete shall be per specification; minimum 2500 PSI.
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 and post spacing.
4. The Cable Barrier System is accepted by the FHWA Test Level - 4.
5. See the specification for delineation.
6. Rock Clause: Where solid rock is encountered:
   - 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.
7. The Gibraltar cable barrier system shall be installed in standard compacted soil. Soil must be well drained.
8. All non-welded rebar by others.
9. Line and Terminal Post Foundation Reinforcement Options
   - 9.A. Without mowstrip, 36" Deep x 12" diameter foundations with #3 rebar ring x 8" diameter with two #4 rebar vertical bars 30" long or 30" welded rebar socket.
   - 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 socket.
   - 9.C. With 3" minimum depth concrete mowstrip, 24" deep x 12" diameter foundations. (No rebar required) .

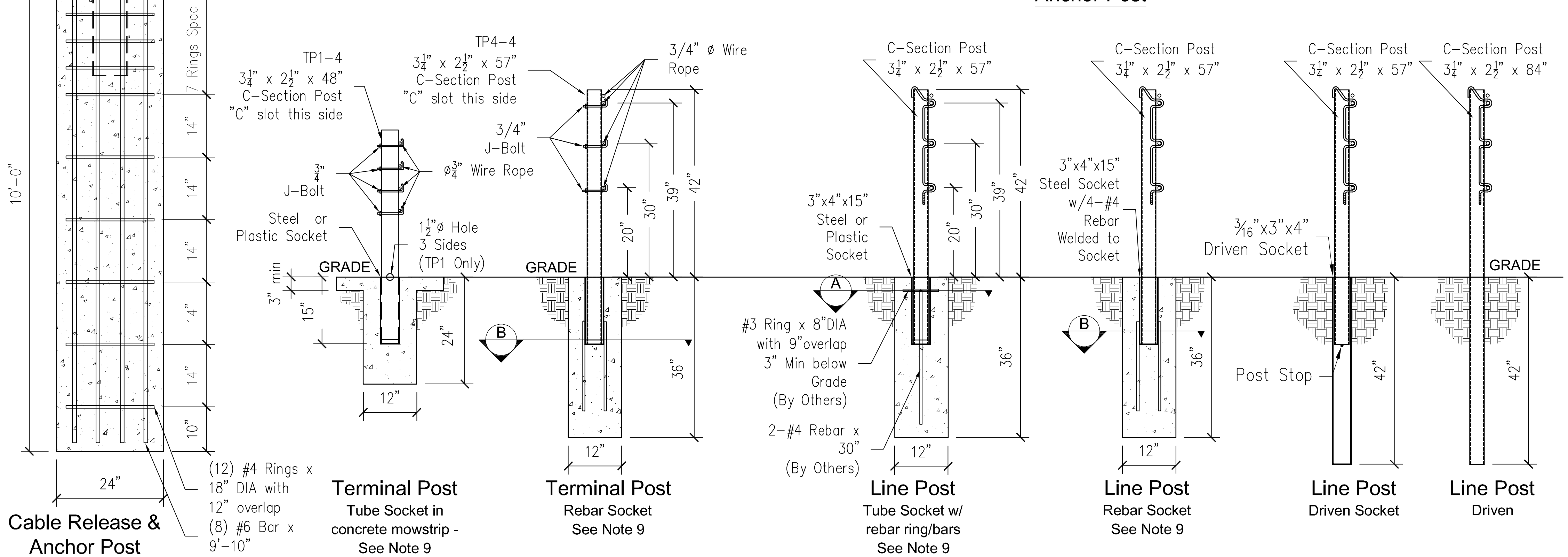






Cable Tension Chart*	
-10 °F	8600
0 °F	8200
10 °F	7800
20 °F	7400
30 °F	7000
40 °F	6600
50 °F	6200
60 °F	5800
70 °F	5400
80 °F	5000
90 °F	4600
100 °F	4200
110 °F	3800

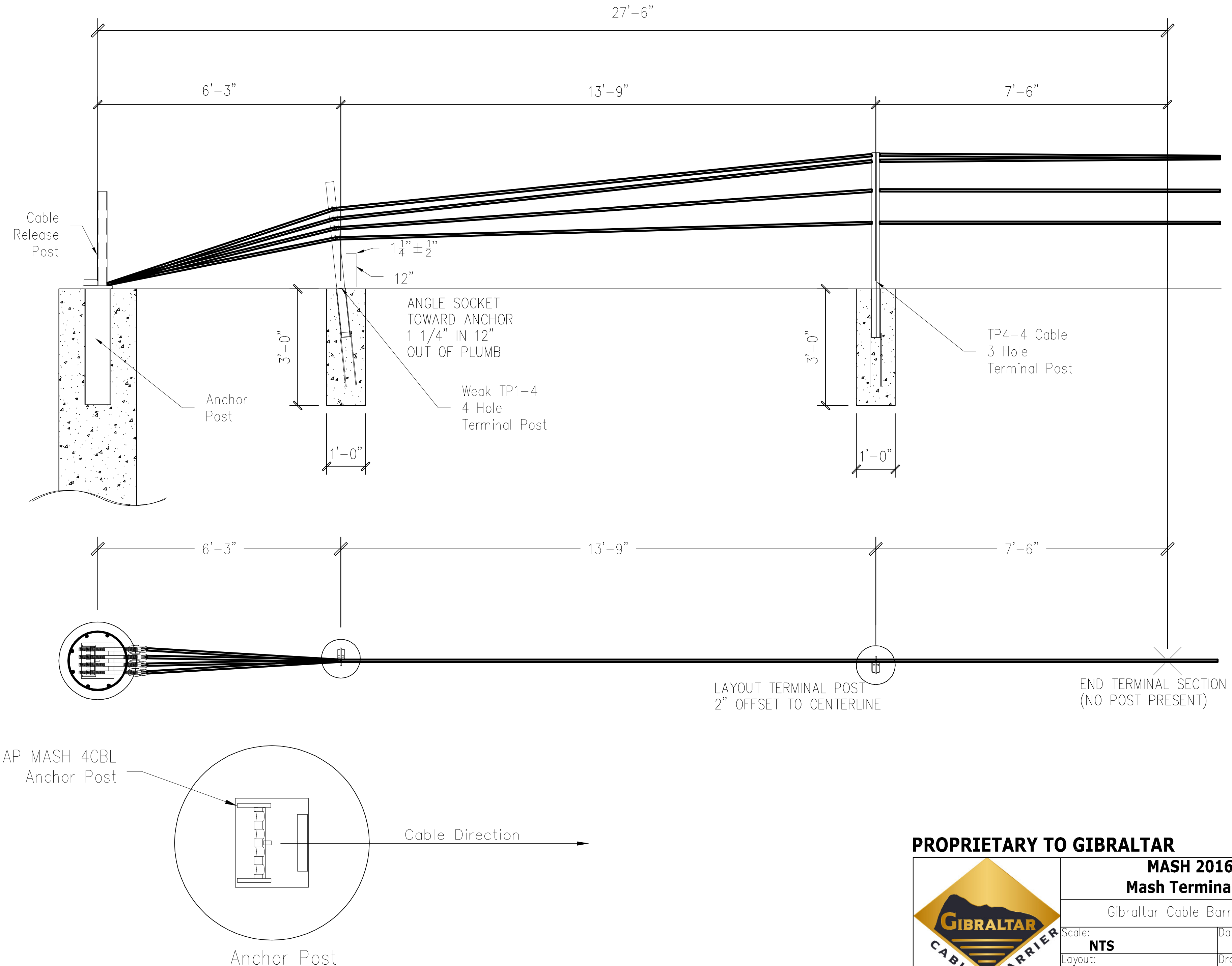
*Allowable Deviation from Chart +/- 10%



PROPRIETARY TO GIBRALTAR

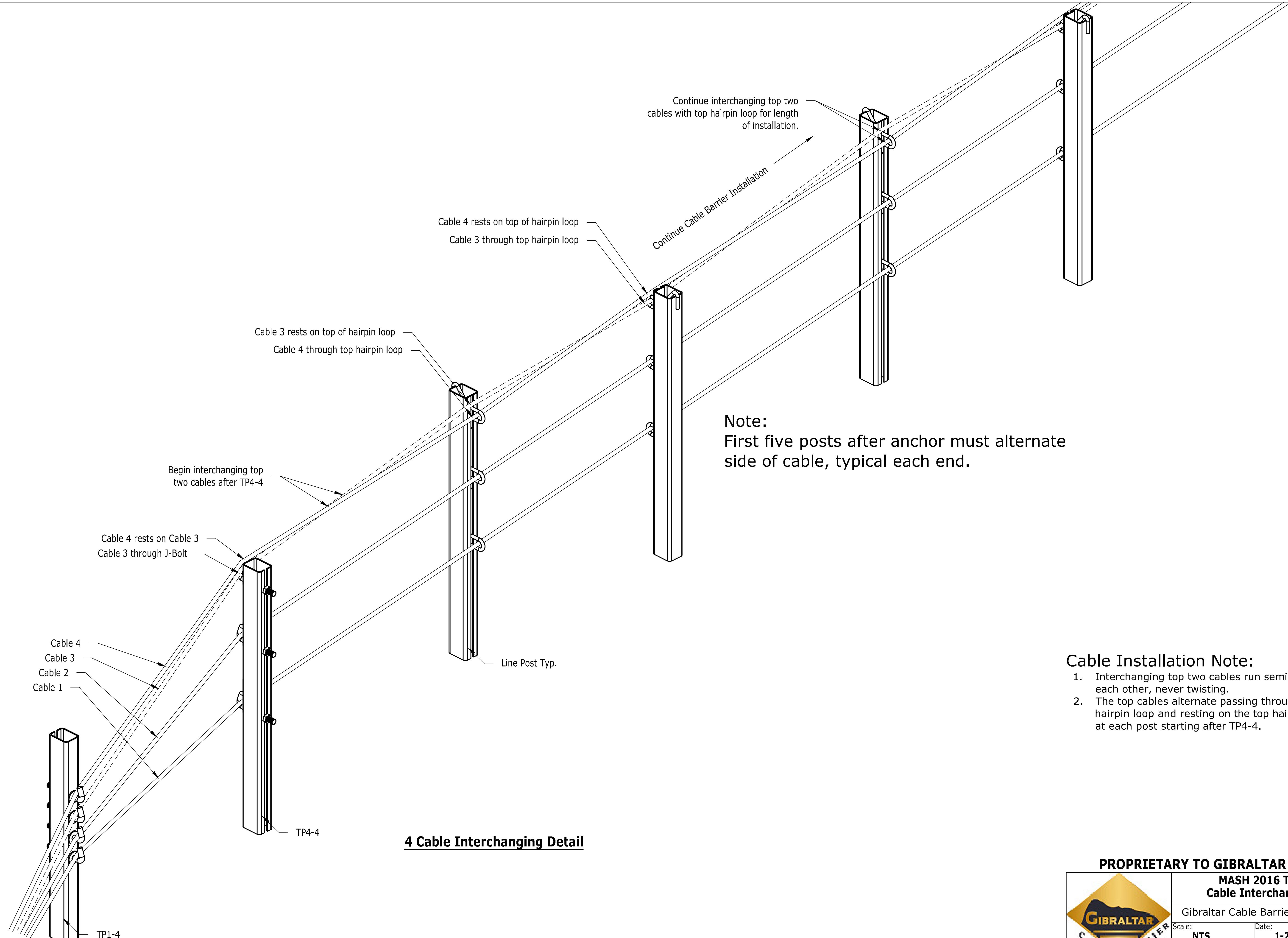
MASH 2016 TL4 Cable System Layout	
Gibraltar Cable Barrier Systems	
Scale: NTS	Date: 8-26-21
Layout: ANSI B	Drafter: BH

GIBRALTAR CABLE BARRIER



PROPRIETARY TO GIBRALTAR

MASH 2016 TL3 **Mash Terminal Layout**	
Gibraltar Cable Barrier Systems	
Scale: **NTS**	Date: **8-26-21**
Layout: **ANSI B**	Drafter: **BH**



4 Cable Interchanging Detail

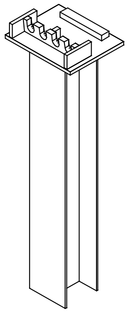
Note:
First five posts after anchor must alternate side of cable, typical each end.

Cable Installation Note:

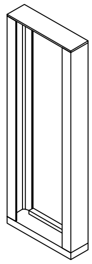
1. Interchanging top two cables run semi-parallel to each other, never twisting.
2. The top cables alternate passing through the top hairpin loop and resting on the top hairpin loop at each post starting after TP4-4.

PROPRIETARY TO GIBRALTAR

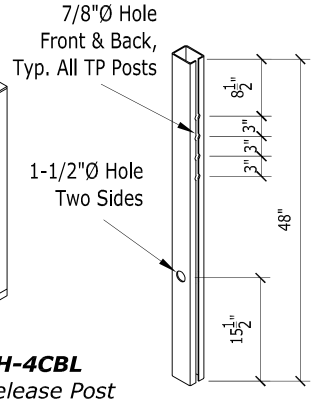
MASH 2016 TL4 Cable Interchanging	
Gibraltar Cable Barrier Systems	
Scale: **NTS**	Date: **1-2-19**
Layout: **ANSI B**	Drafter: **JP**



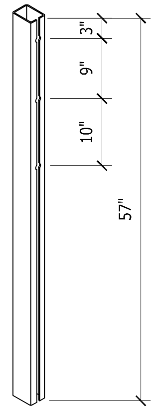
AP-MASH-4CBL
MASH Anchor Post



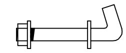
CRP-MASH-4CBL
MASH Cable Release Post



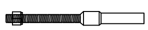
TP1-4
Terminal Post
No. 1/Weak



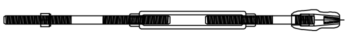
TP4-4
Terminal Post



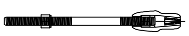
J-BLT
J-Bolt



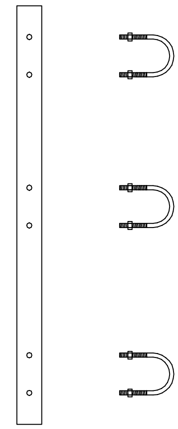
RH STUD ATF ASSY
Anchor Terminal Fitting RH Stud



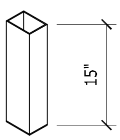
ATF
Anchor Terminal Fitting



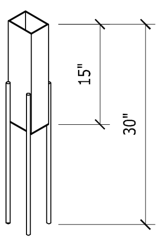
ATF-END
Anchor Terminal Fitting End



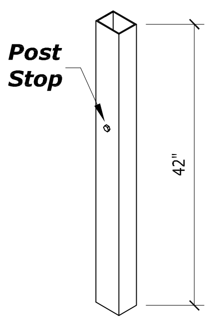
U-Bolt Lock-Plate Assembly



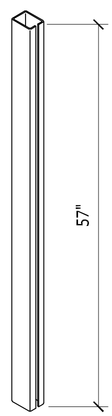
Tube Socket
(Steel or Plastic)



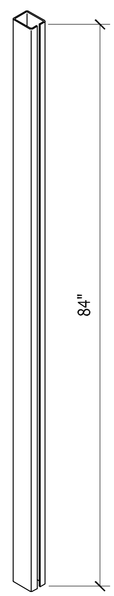
SOCK-S
Short Rebar Socket



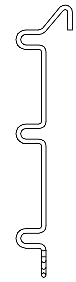
TUBE-D
Driven Socket



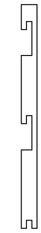
4-LNP-S
Line Post/Socketed



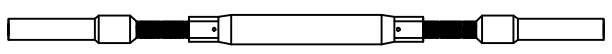
4-LNP-D
Line Post/Driven



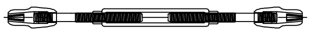
4-HPIN Alum.
3 Cable Alum. HPIN



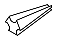
4-LOCK
TL4 Lockplate



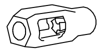
RH/LH SWAGE ASSY



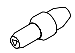
CSTB
Cable Splice Turnbuckle



WEDGE



ACORN
Acorn w/ Wedge



TORP
Longitudinal Section ONLY
Torpedo Cable Splice

PROPRIETARY TO GIBRALTAR

MASH 2016 TL4 System Parts	
Gibraltar Cable Barrier Systems	
Scale: **NTS**	Date: **8/26/21**
Layout: **ANSI B**	Drafter: **BH**

Return to Table of Contents

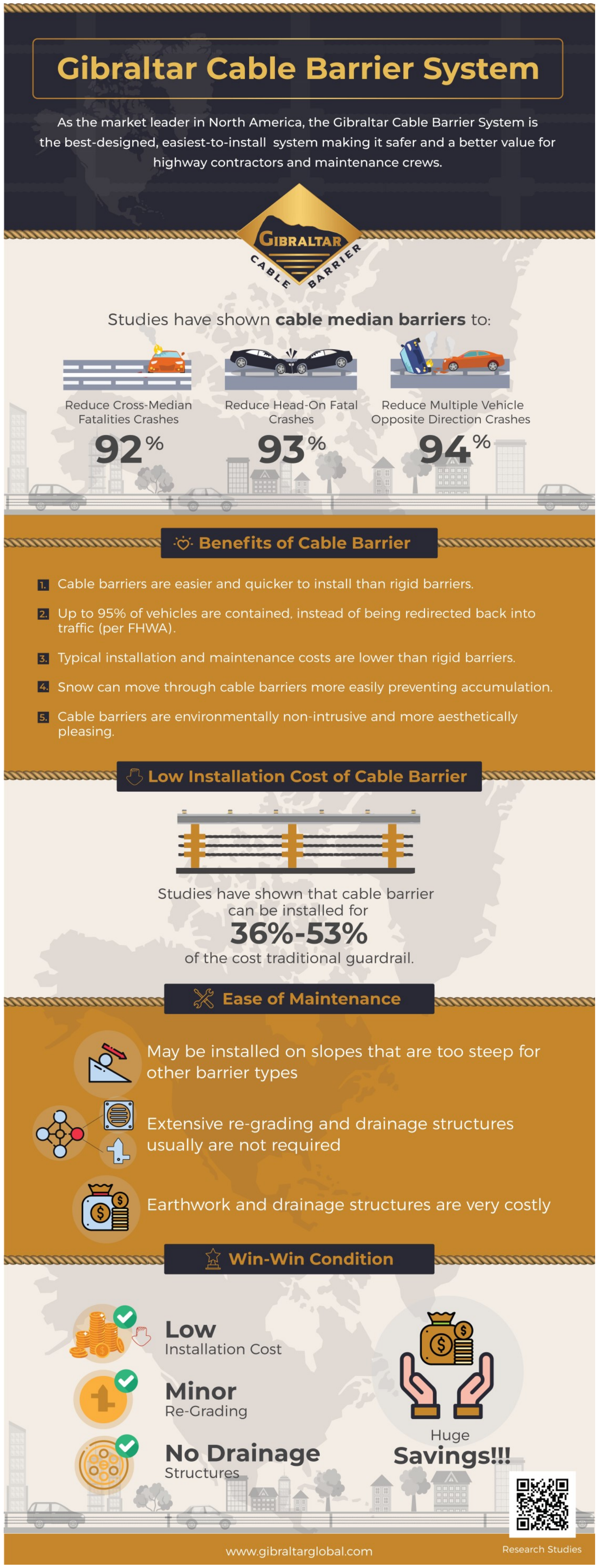
MASH 2016 TL4 CABLE BARRIER SYSTEM

RESEARCH

Gibraltar Cable Barrier System
1208 Houston Clinton Dr.
Burnet, Texas 78611
+1(512) 715-0808
WWW.GIBRALTARGLOBAL.COM

Updated: February 2022

Return to Table of Contents



Updated: February 2022

Return to Table of Contents

RESEARCH STUDIES

Safety Evaluation of Cable Median Barriers in Combination with Rumble Strips on Divided Roads
U.S. Department of Transportation
August 2017

...The results from Missouri for total and injury and fatal crashes were very similar to the combined Illinois and Kentucky results. However, the reduction in cross-median crashes in Missouri was much more dramatic, showing a 96-percent reduction (based on cross-median indicator only) and an 88-percent reduction (based on cross-median indicator plus head-on). The economic analysis for benefit-cost ratios shows that this strategy is cost beneficial.

Read complete study

Evaluation of Safety Effectiveness of Median Cable Barriers Installed on Freeways in Ohio
University of Dayton
August 2018

...Safety effectiveness of Ohio's statewide cable barrierswas found to be 73.9 percent for total crashes, 80.4 percent for fatal and injury (FI) crashes combined and 80.1 percent for fatal, incapacitating, and non-incapacitating injury (KAB) crashes combined.

Read complete study

Minnesota Department of Transportation
July 2017

...Studies of existing cable median barrier installations show dramatic decreases in fatal and serious injuries due to cross median crashes. Cable median barriers can reduce fatal crashes by 95 percent. There are few safety devices available that virtually guarantees consistent success in saving lives every year on divided highways. Since the first installation in 2004, cable median barriers have saved approximately 148 lives in Minnesota.

Read complete study

Return to Table of Contents

Performance Assessment of Road Barriers in Indiana
Joint Transportation Research Program
Purdue University

...Median cable barriers were found to be the most effective among all the studied barriers due to the smallest increase in the crash frequency and least severe injuries in barrier-relevant crashes. A cable barrier's offset to the travelled way was also investigated in this study. When considering vehicles moving in one direction, the nearside cable barriers installed at an offset less than or equal to 30 feet performed better than far-side cable barriers with a larger offsets thanks to the better protection they provide for vehicles against rollovers in the median and impact with the median drain. Consequently, the biggest safety benefit can be expected where cables barriers are installed in the median at both edges.

Read complete study

Center for Transportation Research and Education
Iowa State University
May 2018

...This study involved an in-service performance evaluation to assess the efficacy of median cable barrier systems that have been installed in Iowa to date. In addition to examining impacts on traffic crashes, injuries, and fatalities, the study also involved an economic analysis of the cable barrier systems. The results show that median cable barrier systems have significantly reduced the number of fatal and severe injury crashes across the state. While these reductions have been accompanied by significant increases in less severe crashes, particularly property damage-only collisions, the barrier systems have been shown to provide a significant return on investment. The results of this study suggest that further implementation of median cable barrier systems is warranted. As such, installation guidelines are recommended based on various combinations of median width and annual average daily traffic.

Read complete study

Study of High-Tension Cable Barriers on Michigan Roadways
Wayne State University
October 2014

...The Michigan Department of Transportation (MDOT) began installing high- tension cable median barriers in 2008 and has installed approximately 317 miles of high-tension cable median barrier on state freeways as of September 2013. Given the capital costs required for this installation program, as well as the anticipated annual maintenance and repairs costs, a comprehensive evaluation was conducted in order to ascertain the efficacy of cable barrier systems that have been installed to date. Statistical analyses showed that fatal and incapacitating injury crashes were reduced by 33 percent after cable barrier installation. The analysis also showed the median-crossover crash rate was reduced by 86.8 percent and the rate of rollover crashes was reduced by 50.4 percent.

Read complete study

Return to Table of Contents

MASH 2016 TL4 CABLE BARRIER SYSTEM

MEDIA / TESTIMONIALS

GIBRALTAR CABLE BARRIER SYSTEM
1208 HOUSTON CLINTON DR.
BURNET, TEXAS 78611
+1 (512) 715-0808
WWW.GIBRALTARGLOBAL.COM

Updated: February 2022

UD study: Highway Cable Barriers Prevent most Dangerous Crashes

Dayton Daily News
By Chris Stewart, Staff Writer
July 6, 2020

Hundreds of miles of median cable barriers on Ohio highways have proven to prevent serious and deadly crashes, a University of Dayton Transportation Engineering Lab study shows.

Just 1.7% of vehicles breached median cable barriers and crashed into oncoming traffic out of 2,209 crashes when a driver hit or crossed the cables during the researchers' study period."

It is staggering to guess what percentage of severe crashes would have been caused if all vehicles in these crash events were able to cross through the median and reach opposing travel lanes, which increases the probability of being involved in head-on type of crashes," the UD researchers Deogratias Eustace and Mohammad Almothaffar wrote in their study.

A Federal Highway Administration analysis of crash data from 2014 to 2016 showed more than half of all fatalities — 53% — were the result of cross-median crashes.

The UD study found about 95% of vehicles in crashes did not breach cable barriers while 2.9% breached the barriers but did not cross into oncoming traffic.

"The intention of putting up those barriers was to prevent the most dangerous type of crashes. I think the barriers have performed as expected," said Eustace, director of the UD Transportation Engineering Lab.

The study also showed barriers stopped motorcycles 100% of the time, passenger cars 96.5% of the time, light trucks 95.5% of the time, medium trucks 88% of the time and heavy trucks 85.9% of the time.

Read the entire article: https://www.daytondailynews.com/news/transportation/study-highway-cable-barriers-prevent-most-dangerous-crashes/eVYhEYOTiDJm6dVMmSbDpL/

December 6, 2019

Thank You from Grateful Father

The Michigan Department of Transportation has installed Gibraltar Cable Barriers in several counties throughout the state. The department recently received a thank you note that they shared with Gibraltar:

We received this thoughtful and appreciative e-mail from a retired Eaton County sheriff deputy regarding median cable guardrail and a crash on I-96 last week:

"This morning there was a serious (crash) on I-96 in the area of Mt. Hope Highway in which a semi tanker truck went out of control and started to cross the median from the westbound lane toward the eastbound side. It stuck and was stopped by the cable barrier that was in that area closest to the eastbound lanes. While the truck was heavily damaged and rolled up on its side, it was contained by the barrier.

If you look at the photograph leading the story on WLNS-6 web page … you will see an ECSD SUV on the eastbound side lane. That is where my oldest son Bryan was this morning on the way to work, when the truck hit the wire barrier. He said pieces of the debris from the truck hit him as it happened. He was shaken, considerably, but able to call me after settling down. He told me that the barrier, which we've all grumbled about at times, saved his life as it's certain the truck would have continued into his path and killed him and possibly a number of others, as traffic was heavy at that time.

On behalf of my son, his two kids, and our whole family, we want to tell you how grateful we are that MDOT has invested in the cable barriers. We all thank your organization for the planning and forethought that went into the implementation of the cable barriers."

Read complete story

Return to Table of Contents

System being Installed in Shelby County

SIDNEY DAILY NEWS
JULY 18, 2019

By Kyle Shaner
SIDNEY – Installation of high tension cable barriers along Shelby County highways is almost complete, which the Ohio Department of Transportation expects will save lives.

Jay Winn, a regional sales manager for Gibraltar Cable Barrier Systems in Texas, visited ODOT's Shelby County garage on Wednesday to speak to approximately 35 people including ODOT employees, police officers, emergency medical technicians and tow truck drivers. His presentation informed the attendees about the barriers, how to repair them and offered safety tips for working around them.

"It's a little different than most systems that you see out there but very effective," Winn said of the cable system.
The high tension cable barriers are designed to act like a net when a vehicle hits them. Anchors are embedded into the ground and hold tension on cables that catch vehicles after they strike the system.

Read entire article.

Cable Barriers in the Median on Michigan Highway Save Lives in Multi-Vehicle Pileup

They look like tuna-netting and tear up cars but Michigan's cable guardrails save lives.

Plunging temperatures and freezing precipitation wreaked havoc on Michigan roads on January 12 (and many other days). Not one, but two eighteen-wheelers jack-knifed on a busy section of I-96 in Ionia County but it was the cable guardrails that saved lives. The posts were toppled but the steel ropes held and the trucks were prevented from crossing the median into oncoming traffic.

Read full article.

Cable Barrier Saves Truckers from Catastrophic Head-on Collision

A semi truck driver has shared dash cam video of a frightening near miss with another out of control tractor trailer. The dash cam video was captured on I-40 about 60 miles east of Little Rock, Arkansas, on February 19.

In the video, you can see the dash cammer traveling in the left lane of the interstate when a truck head-ing the opposite direction loses control, barrels through the median, and seems just moments from enter-ing oncoming traffic. At the last moment, the oncoming truck driver hits a cable barrier in the median, preventing it from crashing into the dash cammer and other vehicles.

Cable Median Barriers Save Lives

Minot Daily News
May 1, 2020

Safety on our roadways is the top priority for the North Dakota Department of Transportation (NDDOT). In 2018 NDDOT launched the Vision Zero safety initiative with a goal of zero motor vehicle fatalities and seri-ous injuries on North Dakota roads. As part of that initiative the NDDOT reviewed crash data and identified lane departure crashes, which includes cross-median crashes, as one of the top crash emphasis areas in the state.

Cross-median crashes occur when a vehicle departs the roadway of a divided highway, crosses the median, and strikes an object or a vehicle traveling in the opposing direction. These types of crashes present the high-est risk of fatal and severe injuries among all collision types on highways. Median-crossover crashes are caused by a variety of factors including: driver distraction, impaired driving, mechanical failure, and loss of vehicle control.

Read entire article

Return to Table of Contents

MASH 2016
TL4 CABLE BARRIER SYSTEM

INSTALLATION GUIDE

Gibraltar Cable Barrier System
1208 Houston Clinton Dr.
Burnet, TX 78611
(512) 715-0808
www.gibraltarglobal.com

[Note to Installer: Refer to Contract Plans and Documents for Specific Details]
The Gibraltar Cable Barrier Systems are covered by one or more of the following patents: U.S. Patent No(s).: 7,364,137; 7,398,960; and 7,401,996. Other U.S. and International patents are pending

Version 8.0
Updated: 5/23

INSTALLATION GUIDE

Table of Contents

Welcome

Welcome to the Gibraltar Cable Barrier System Installation and Maintenance Guide. This guide is for your use when installing Gibraltar's cable barrier system. This installation guide is for standard cable barrier installations.

Before You Begin:
Check and confirm packing list contents. Please report any errors or shortages immediately to Gibraltar at: (833) 715-0810 or (512) 715-0808.

System Installation & Components

Cable Barrier System – Longitudinal Section Layout
Cable Barrier System – Terminal Section Layout
Cable Interchanging
Parts Lists

Equipment/Tools Required

1. Auger (for Socketed Line Post and Terminal Post foundations)
2. Auger (Anchor Post foundation)
3. Post Driver (for Driven Post option)
4. Adjustable Wrench (2)
5. Tension Meter
6. Utility Trailer (rigged for Wire Rope Spools)
7. Flathead Screwdrivers (2)
8. 3 Ton (6000 lb.) Chain Hoist (6 Ton hoist may be required in cold climates)
9. Cable Grabbers (2)
10. Vice Grips (large enough to fit over 3/4in cable) or 3/4in cable clamps
11. Thermometer

GIBRALTAR MASH 2016 INSPECTION CHECKLIST

TERMINAL SECTION

- [ ] Ensure the anchor post is centered in the hole on stringline, the anchor plate is set no more than 1” above grade and is set plumb using the cable release post.

- [ ] Ensure terminal post #1 leans 1 ¼” every 12” out of plumb towards the anchor and the top of the socket is at grade (p. 5).

- [ ] Ensure the second terminal post socket is set plumb and the top is set at grade.
  Ensure the terminal posts “open” side is away from the center line (p. 6), and the j-bolts are installed.

- [ ] Ensure the cables are set in each j-bolt and on the 2nd terminal post, the top cable is resting on the 3rd cable (p. 6)

- [ ] Ensure all fittings are installed correctly with the wedge correctly installed in the acorn fitting (p. 7 & 12).

LENGTH OF NEED

- [ ] Ensure line post sockets are set plumb, with the short side of socket on the stringline and the top is flush with grade. A post can be used to make sure the socket is plumb.

- [ ] Ensure posts are set in the sockets with the open C is facing the cables, and the hairpin and lockplates are installed in each post.

- [ ] The posts in the terminal and the next five posts after the terminal must alternate on sides of cable, the remaining posts should alternate throughout the system. In some cases, it is not possible to have all posts on alternating sides of cable, 3 posts on the same side of cable is acceptable in these situations, contact Gibraltar if this occurs more than once in a single run.

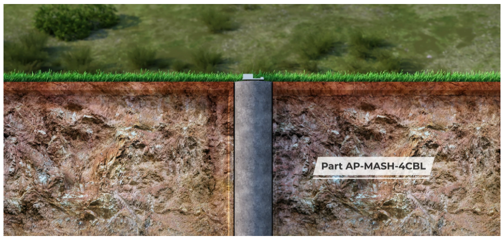
- [ ] Ensure each cable of each run has at least one set of cable splice turnbuckles (CSTB). The turnbuckles should be no greater than 2,000 ft apart. Ensure the CSTBs on the top two cables are separated and are not touching each other.

- [ ] Ensure the cables are properly installed in each post utilizing the hairpin and lockplate design. The top two cables should alternate being in the top hoop of the hairpin and being set on top of it. There should be no twisting of the cables from post to post. (p. 11)

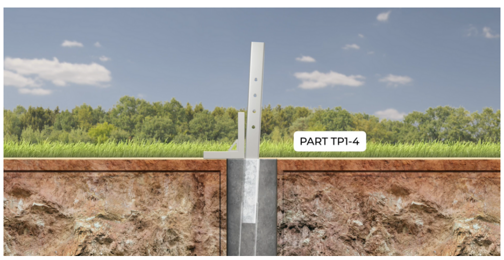
- [ ] Ensure the cables are all tensioned within 10% of the tension chart shown on the drawings and are noted in a tension log.

GIBRALTAR MASH 2016 INSPECTION CHECKLIST

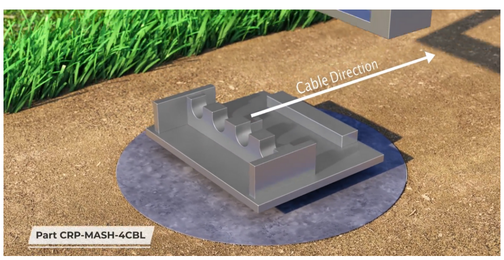
TERMINAL SECTION



- ☐ Ensure the anchor post is centered in the hole on stringline, the anchor plate is set no more than 1” above grade and is set plumb using the cable release post.

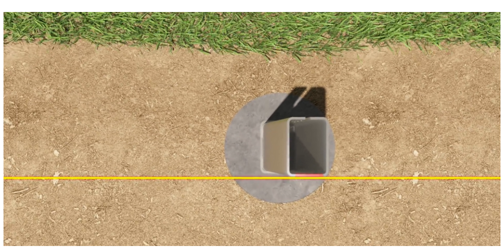


- ☐ Ensure terminal post #1 leans 1 ¼” every 12” out of plumb towards the anchor and the top of the socket is at grade (p. 5).

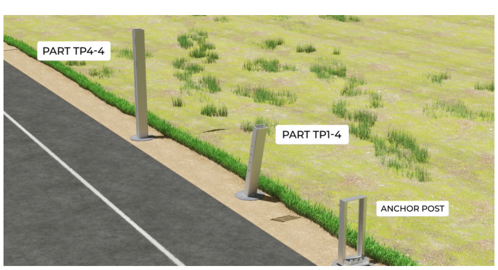


- ☐ Ensure the second terminal post socket is set plumb and the top is set at grade.

- ☐ Ensure the terminal posts “open” side is away from the center line (p. 6), and the j-bolts are installed.



- ☐ Ensure the cables are set in each j-bolt and on the 2nd terminal post, the top cable is resting on the 3rd cable (p. 6)



- ☐ Ensure all fittings are installed correctly with the wedge correctly installed in the acorn fitting (p. 7 & 12).

GIBRALTAR MASH 2016 INSPECTION CHECKLIST

LENGTH OF NEED

- [ ] Ensure line post sockets are set plumb, with the short side of socket on the stringline and the top is flush with grade. A post can be used to make sure the socket is plumb.

- [ ] Ensure posts are set in the sockets with the open C is facing the cables, and the hairpin and lockplates are installed in each post.

- [ ] The posts in the terminal and the next five posts after the terminal must alternate on sides of cable, the remaining posts should alternate throughout the system. In some cases, it is not possible to have all posts on alternating sides of cable, 3 posts on the same side of cable is acceptable in these situations, contact Gibraltar if this occurs more than once in a single run.



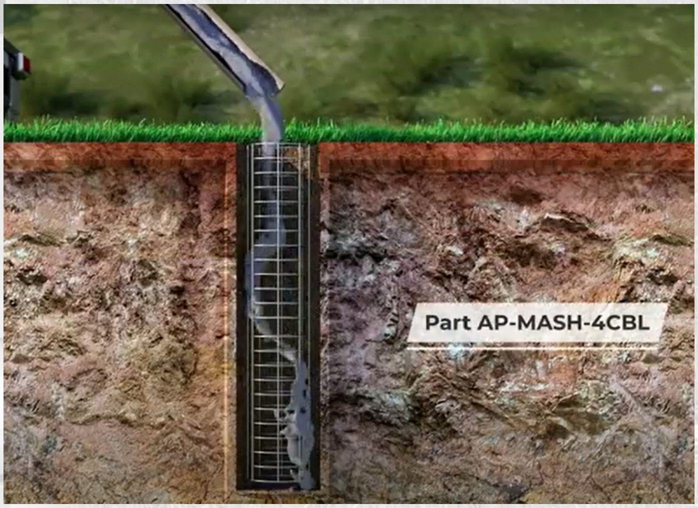
- [ ] Ensure each cable of each run has at least one set of cable splice turnbuckles (CSTB). The turnbuckles should be no greater than 2,000 ft apart. Ensure the CSTBs on the top two cables are separated and are not touching each other.

- [ ] Ensure the cables are properly installed in each post utilizing the hairpin and lockplate design. The top two cables should alternate being in the top hoop of the hairpin and being set on top of it. There should be no twisting of the cables from post to post. (p. 11)

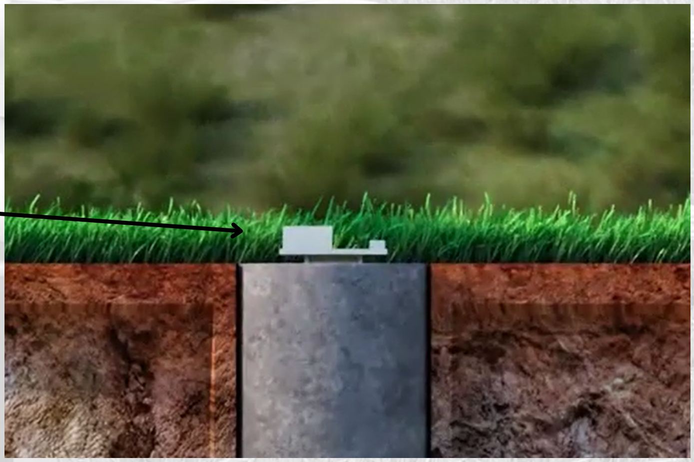
- [ ] Ensure the cables are all tensioned within 10% of the tension chart shown on the drawings and are noted in a tension log.

ANCHOR INSTALLATION

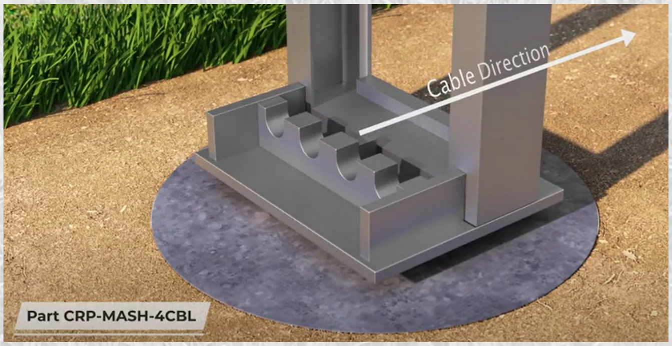
1) Begin by drilling the appropriate size anchor hole. Install the rebar cage, then fill it with concrete.



2) Set the anchor posts in concrete. The top plate on the anchor posts should be no more than 1" above grade and the post should be installed plumb.



3) Set the cable release post (CRP) on top of the anchor post. If the CRP is not plumb than the anchor post should be adjusted so that the CRP is plumbed.



ANCHOR INSTALLATION
(CON'T)

Critical Points

- Anchor Post and Cable Release Post should be plumb.

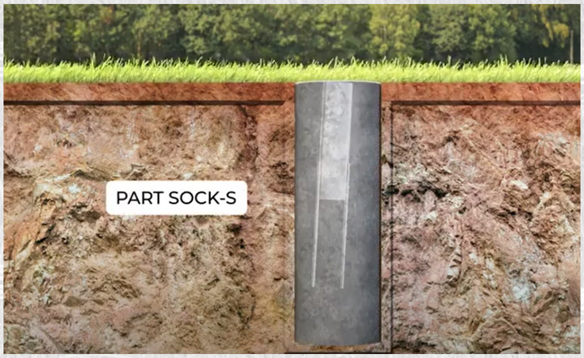
- Anchor Post Plate should be no more that 1" above concrete.

- Install Cable Release Post as shown.

TERMINAL POST SOCKET

1) Start the first terminal post socket by drilling the appropriate size socket hole and filling it with concrete.

2) Install the socket into the concrete. The socket type may be different than shown. This particular socket is the only socket that is set at an angle.

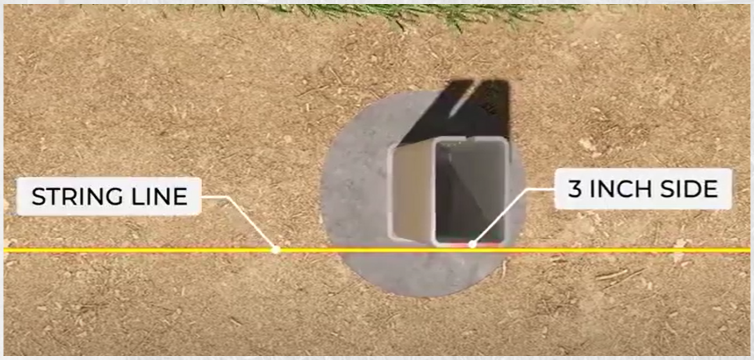


The socket should be set so that the top of the socket is flush with grade.

3) Insert the socket at an angle so that when TP1-4 is placed in the socket, the post is 1-1/4” per 12” out of plumb. Socket and post should lean towards the CRP.

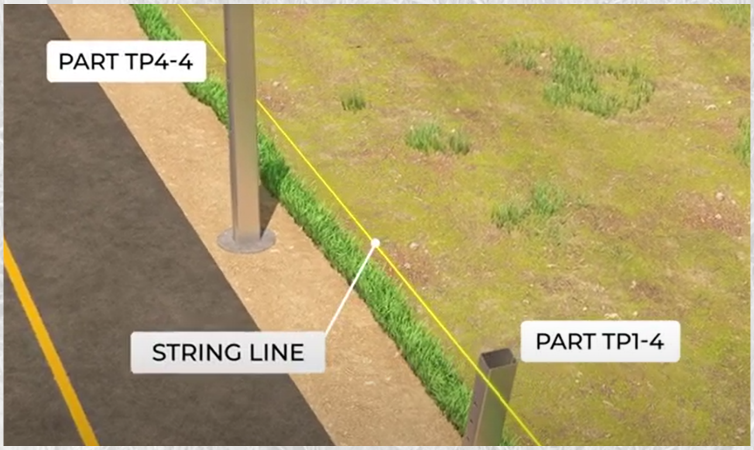
TERMINAL POST SOCKET
(CON'T)

4) Be sure the 3-inch side of the socket is flush with the string line. This string line represents the cable line.



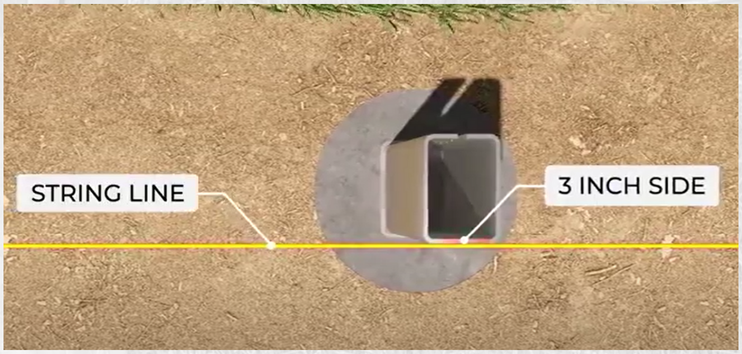
5) The last terminal post socket is set plumb in a socket hole which is filled with concrete.

This socket should be installed on the opposite side of the cable of the TP1-4 socket.



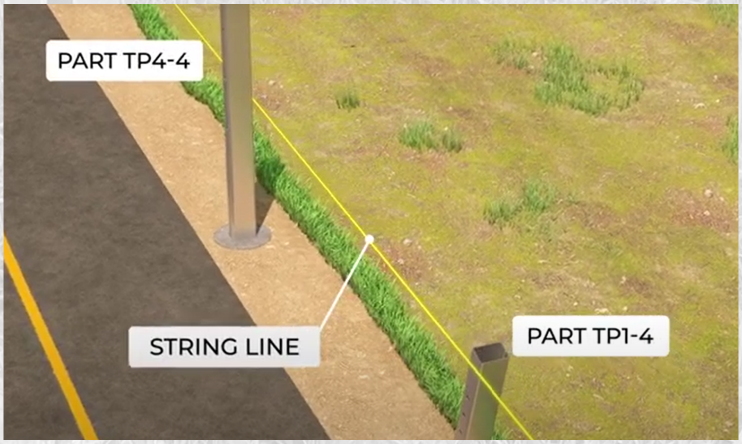
TERMINAL POST SOCKET
(CON'T)

6) Be sure the 3-inch side of the socket is flush with the string line. This string line represents the cable line.



7) The last terminal post socket is set plumb in a socket hole which is filled with concrete.

This socket should be installed on the opposite side of the cable of the TP1-4 socket. Be sure the 3-inch side of the socket is flush with the string line.



TERMINAL POST SOCKET
(CON'T)

Critical Points

- Sockets are set on opposite side of cable.

- Short side of socket is on centerline.

- TP1-4 socket is set at an angle - 1-1/4" per 12". Socket should lean towards CRP.

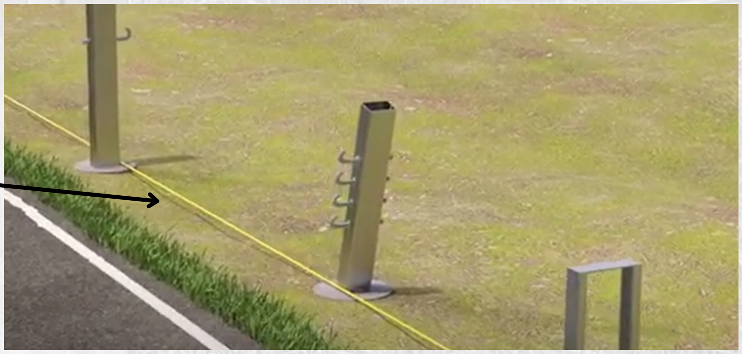
- TP4-4 socket is set plumb.

- TP1-4 socket located at 6'-3" from center of anchor post.

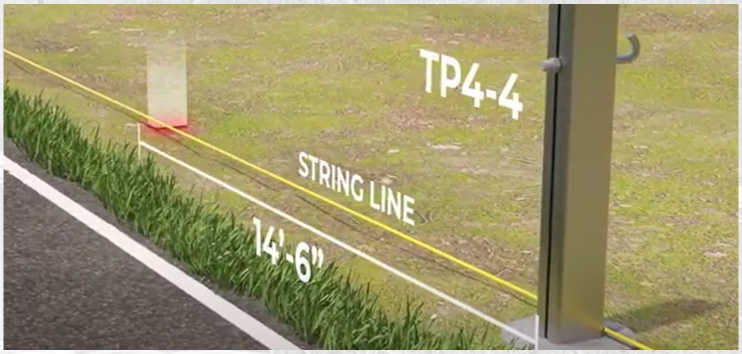
- TP4-4 socket located at 13'9" from center of TP1-4 socket.

LINE POST SOCKET

1) Install a string line representing the cable location for the line post socket installation.



2) Locate the first line post socket at 14'6" from the last terminal post. Noting the socket needs to be on the opposite side of the string line of the TP4-4 post socket hole.

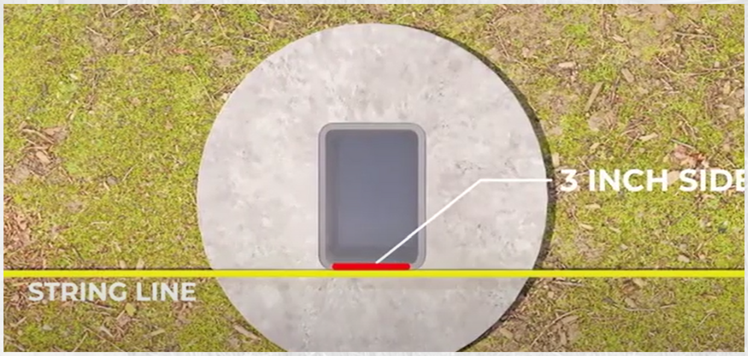


Drill the appropriate size hole with the center of the hole two inches off the string line and fill it with concrete.

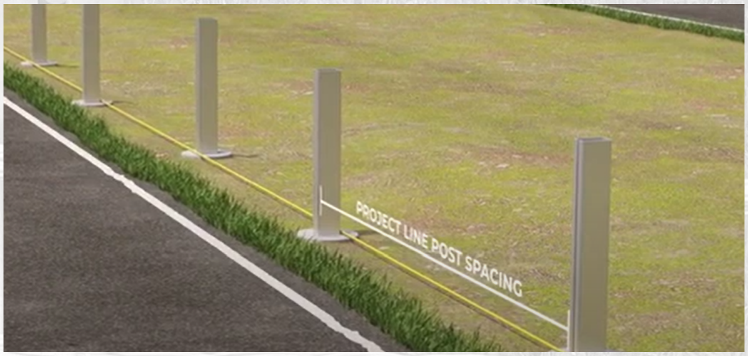
LINE POST SOCKET

(CON'T)

3) Install the socket into the concrete. The socket should be set so that the top of the socket is flush with grade and the socket is plumb. Be sure the 3-inch side of the socket is flush with the string line. This string line represents the cable line.



4) A line post may be placed in the socket once the concrete is sent.



The next line post socket should be placed on the opposite side of the stringline at the project line post spacing and repeated towards the middle of the run.

This procedure is the same for the opposite end of the cable run, and post spacing can be adjusted in the middle of the run.

LINE POST SOCKET

(CON'T)

Critical Points

- Sockets are set on opposite side of cable alternating throughout the installation.

- Short side of socket is on the centerline.

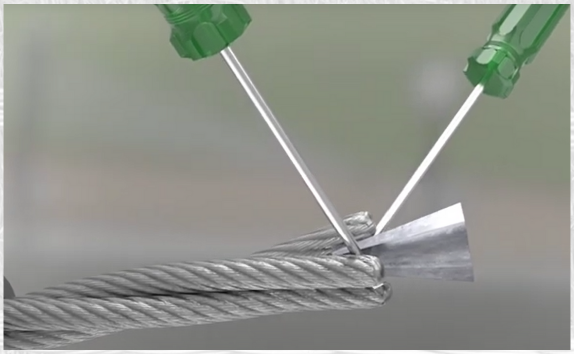
- Line post socket is plumb.

- The first line post socket is placed 14'6" from the the TP4-4 post socket and on the opposite side of the string line of the TP4-4 post socket.

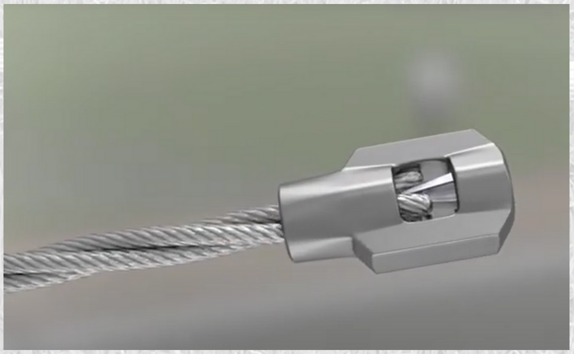
ANCHOR TERMINAL FITTING

1) Connect the four cables to the Anchor Terminal Fittings by inserting the cable ends into the acorn-shaped casting of the cable terminal fittings.

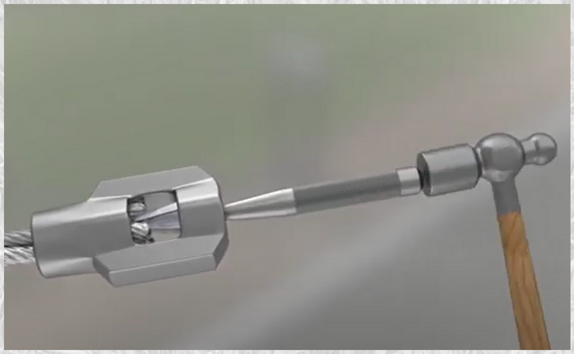
2) Using two flathead screwdrivers, separate the 3 strands of the cable at the end. Place and insert the triangular wedge between the cable strands. The triangular wedge must point toward the cable. The strands will fit in the grooves of the wedge.



3) Remove the screwdrivers and move the acorn up the cable until the wedge and cable are in the acorn as far as they will go.

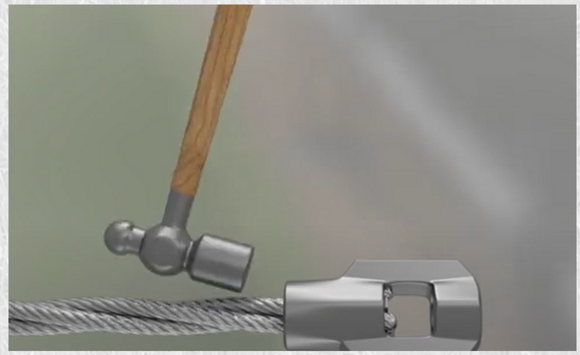


4) With a hammer and punch, drive the wedge into the cable at least 3/8”, but no more than ½” past the end of the cable.

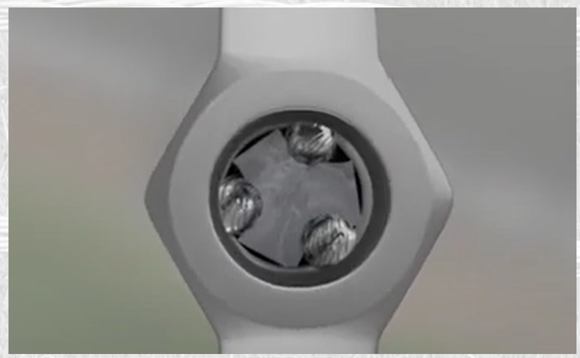


ANCHOR TERMINAL FITTING
(CON'T)

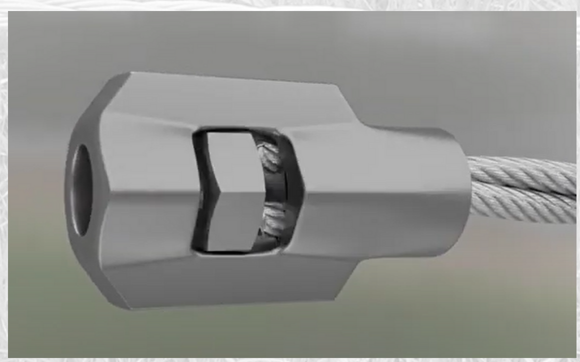
5) Drive the acorn up onto the cable until the top of the wedge is even with the bottom opening in the acorn.



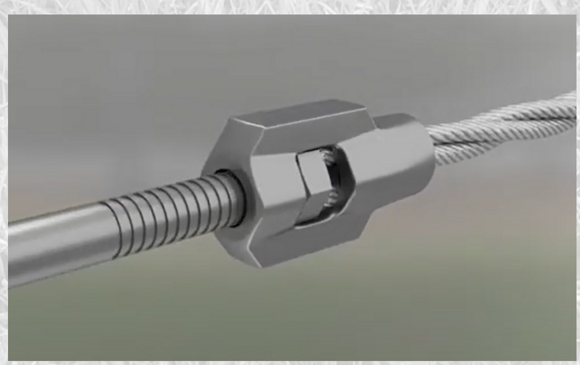
The 3 strands of cable should be nested in the grooves of the wedge.



6) Place the nut inside the opening of the acorn fitting and thread onto the threaded rod.



7) Connect the anchor terminal fittings with cable attached into the anchor post.



ANCHOR TERMINAL FITTING
(CON'T)

Critical Points

• Cable should extend 3/8” to ½” past the end of the wedge.

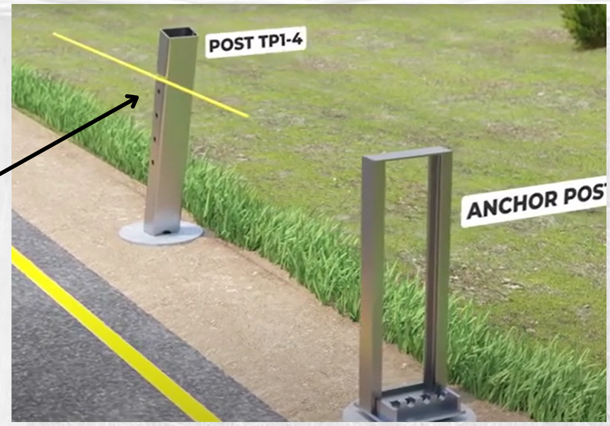
• Top of the wedge should be even with or below the bottom of the opening in the acorn.

• Individual strands of cable should be in the grooves of wedge, and bundles should still be round.

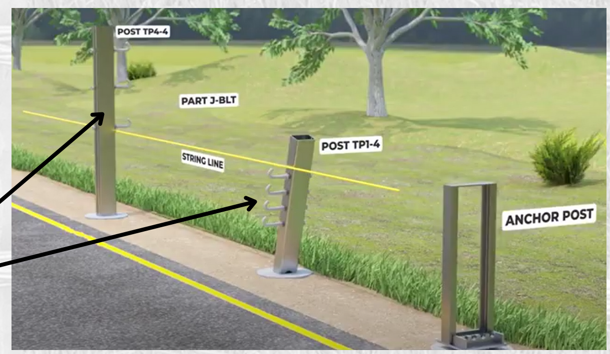
• Install cable release post as shown with 1” plate on bottom and the side with two bars towards TP1-4.

TERMINAL ABOVE GROUND

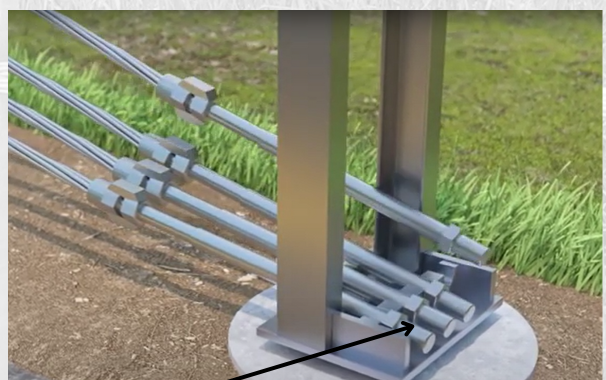
1) Set the cable release posts on top of the anchor post. Place a TP1-4 post in the first socket after the anchor post. Make sure the holes in the side of the post are towards the cable.



2) Place a TP4-4 post in the second socket after the anchor post, making sure the holes in the side of the post are towards the cable. The two terminal posts should be on opposite sides of the cable. Install the J-bolts into the two terminal posts.



3) Place 4 anchor terminal fittings with the cable attached into the slots of the anchor posts. Cables should be placed into the slot starting with the bottom cable and ending with the top cable. It does not matter which side installation is started on. There should be at least 2" of threads passing the nut on the anchor terminal fittings.



4) Place four cables into the J-bolts of the terminal post noting the top tables of the TP4-4 post will have two cables resting in it.

TERMINAL ABOVE GROUND
(CON'T)

Critical Points

- Correct terminal posts in correct locations.

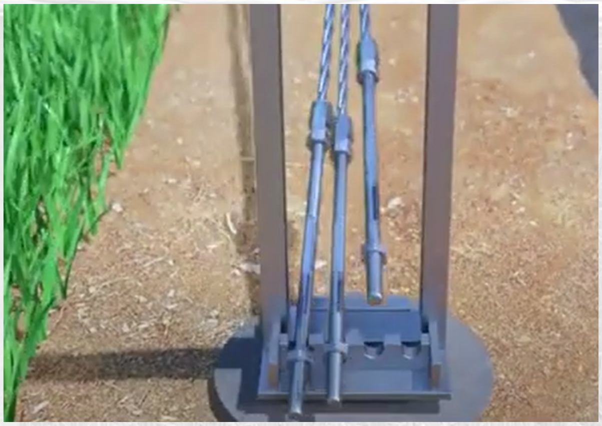
- Holes in terminal posts should be facing the cable.

- Cables placed in the slots of anchor post starting with the bottom cable.

- 2" of thread past the nut is for ease of installation. Only a full nut of threads is necessary for operation. More than a full nut is acceptable.

CABLE DISTRIBUTION

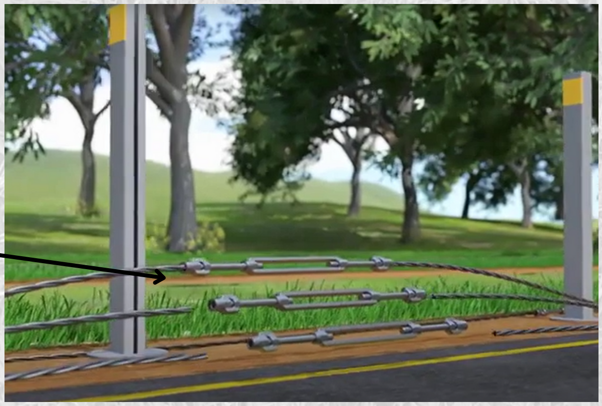
1) Start by connecting the anchor terminal fittings with cable attached into the anchor post.



2) Once the anchor terminal fittings are placed in the anchor post slots, install an ATF retaining tool. This retainer will keep the ATF fittings from working out of the slots while the cable is distributed.

3) Distribute the cables throughout the run with three cables on the side of posts that the system will be hung from and one cable on the opposite side of the posts.

4) Use a CSTB fitting to connect spools of cable together and remember to place the CSTB near a post so the fitting ends up between posts when the system is tensioned.

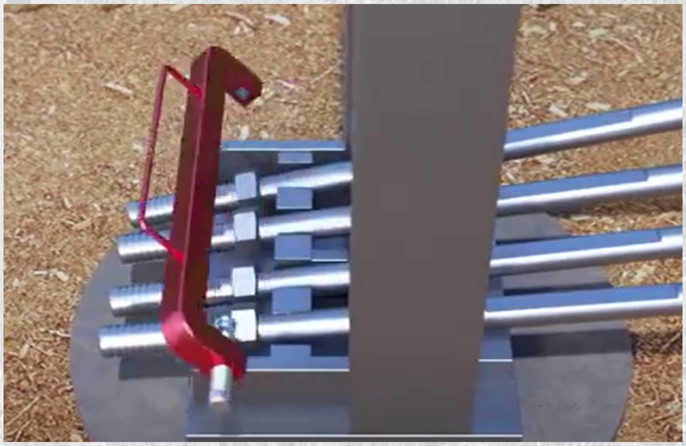


CABLE DISTRIBUTION
(CON'T)

5) The fitting for the top cable should be placed near an adjacent post so that the top two fittings are not on top of each other.

6) Once the cable is tensioned, repeat this process until the end of the run is reached and leave the cable ends loose near the anchor post.

7)ATF retaining tool must be removed when crews are not present or not in use.



CABLE DISTRIBUTION
(CON'T)

Critical Points

- Place 3 cables on the side of the posts the cable will be hung from.

- Place 1 cable on the opposite side of the posts the cable will be hung from.

- The top fittings for the top two cables should be offset so the fittings do not sit on top of one another.

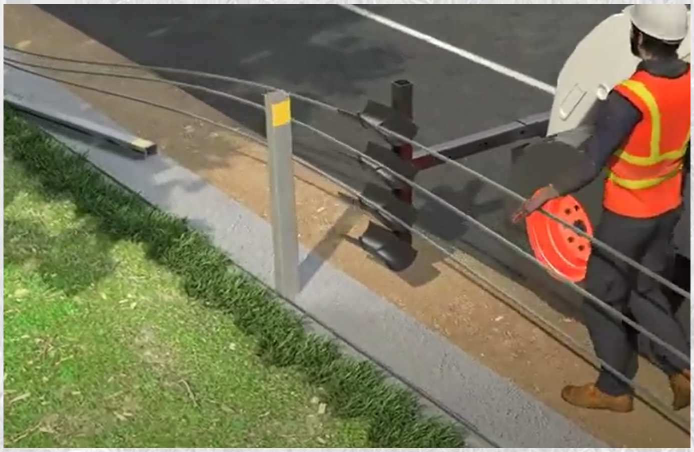
- Remove the ATF Retaining Tool when crews are not present or not in use.

CABLE INTERCHANGING

1) Start by placing only the posts where the slot is facing the side of the system the cable will be hung from. Other posts and hardware should be left out of sockets.

2) Hang three cables throughout the system utilizing a hairpin and lock plate. The fourth cable can remain on the ground.

This process is best performed with a cable hanging device to keep the 3 cables in the correct order.



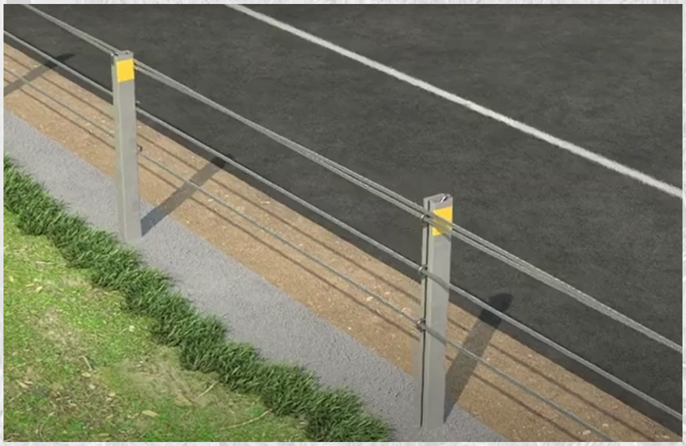
CABLE INTERCHANGING

(CON'T)

3) Tension the 3 cables that were hung up to the appropriate tension. At this point the remaining posts can be installed in the sockets.

4) The cables may be hung at this time with a fourth cable installed in the top loop of the hairpin and the third cable will be placed on top of the hairpin.

5) At the next post, the fourth cable will be placed on top of the hairpin. The top two cables will alternate going through the hairpin. They should never twist with the free cable at the post resting on top of the hairpin. After all the cables are installed, the fourth cable should be taken up to the appropriate tension.



CABLE INTERCHANGING
(CON'T)

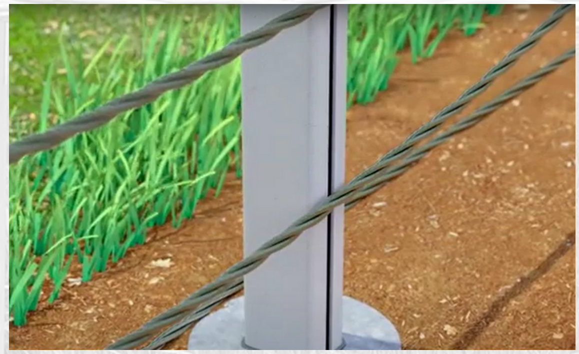
Critical Points

- Top two cables should alternate going through the top loop of the hairpin. They should never twist.

Cable Tension Chart	
-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%	

POST HARDWARE INSTALLATION

1) Slide a post into the socket with 3 cables on the slot side of the post and the fourth cable on the backside of the post.



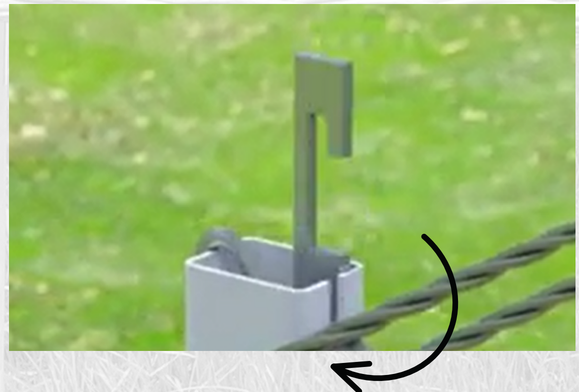
2) Install a hairpin by inserting the base of the hairpin into the post and rotate the hairpin up until the cables are in the loops of the hairpin.

3) Slide the cables and the hairpin up to the post keeping the hairpin top leg in contact by pushing on the loops of the hairpin. This will keep the cables in the loops as the hairpin and cables are slid up the post.

4) Once the top leg of the hairpin clears the top of the post and goes over the post, the assembly can be released and the cables are hung at this time. Bring the fourth cable over the back of the post to the slot side of the post.

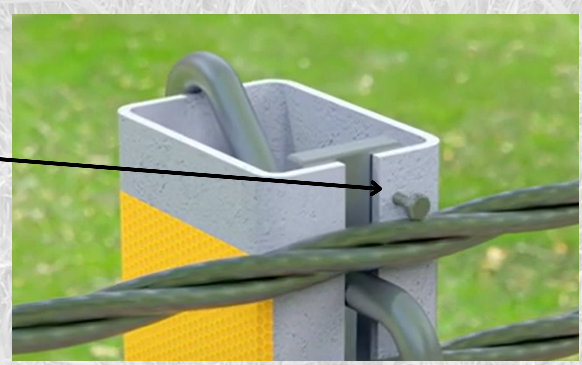
POST HARDWARE INSTALLATION
(CON'T)

5) Install lock plate as shown, then rotate clockwise.



6) Place delineation on the post using the correct color for barrier location and at the project delineation spacing.

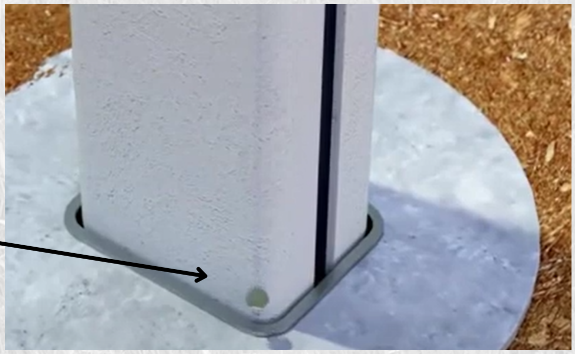
7) In certain cases, because of the terrain, the cables may be too high.



This is corrected by pushing the cables down to the correct height and using a #12 x 3/4" self-drilling, self-tapping screw. Install the screw through the post and into the lock plate to hold the cables at the correct height.

POST HARDWARE INSTALLATION
(CON'T)

8) If the entire assembly is being raised out of the socket, push the assembly down into the socket and use a #12 x 3/4" self -drilling, self-tapping screw installed vertically between the post and socket to hold the entire assembly down at the correct heights.

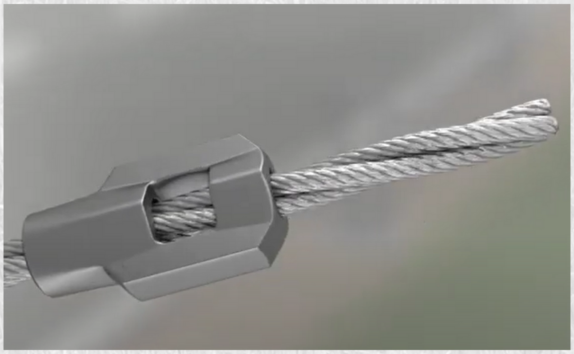


Critical Points

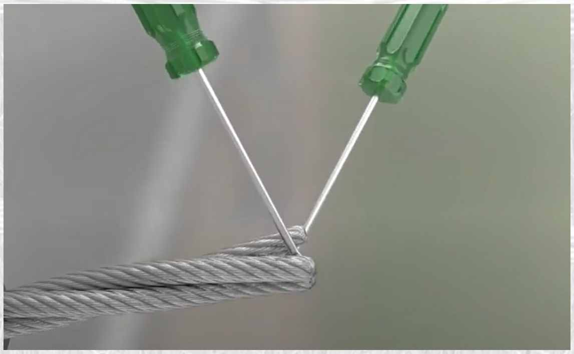
- Hairpin and lockplate installed at every post.
- The 3 cables in the hairpin should be at the correct height when measured at the post.
- Use #12 x 3/4" self-drilling, self-tapping screws to hold posts and hardware to ensure cables are at correct height.
- Delineation installed per project specification.

ACORN WEDGE INSTALLATION

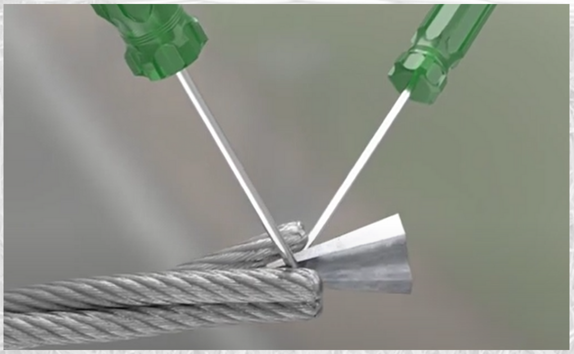
1) Start by inserting the cable ends into the acorn shaped casting.



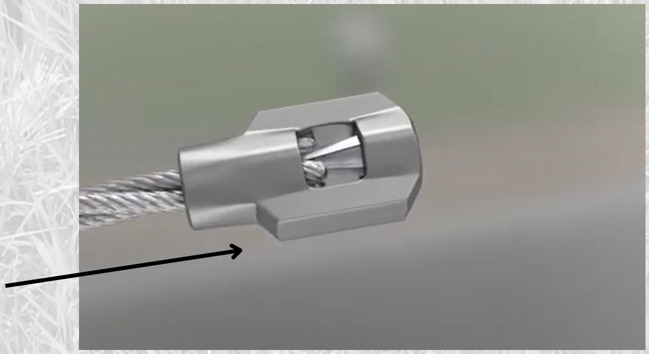
2) Using 2 flathead screwdrivers separate the 3 strands of the cable at the end.



3) Place and insert the triangular wedge between the cable strands. The triangular wedge must point toward the cable. The strands will fit in the grooves of the wedge.

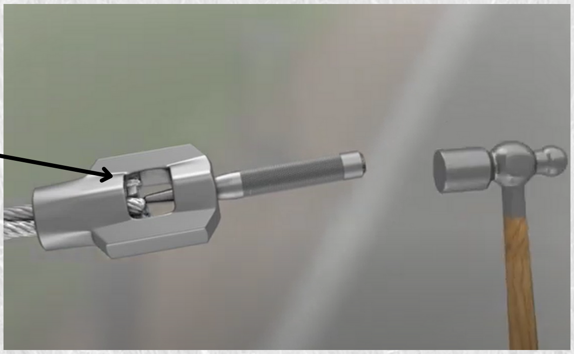


4) Remove the screwdrivers and move the acorn up the cable until the wedge and cable are in the acorn as far as they will go.

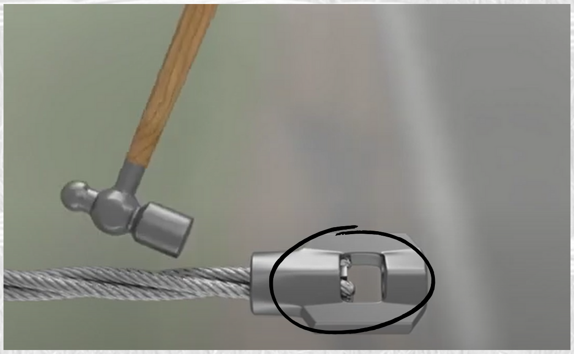


ACORN WEDGE INSTALLATION
(CON'T)

5) With the hammer and punch drive the wedge into the cable at least 3/8" but no more than 1/2" past the end of the cable.



6) Drive the acorn up onto the cable until the top of the wedge is even with the bottom opening in the acorn.



7) The 3 strands of cable should be nested in the grooves of the wedge

ACORN WEDGE INSTALLATION
(CON'T)

Critical Points

- Cable should extend 3/8" to 1/2" past the end of the wedge.

- Top of the wedge should be even with or below the bottom of the opening the acorn.

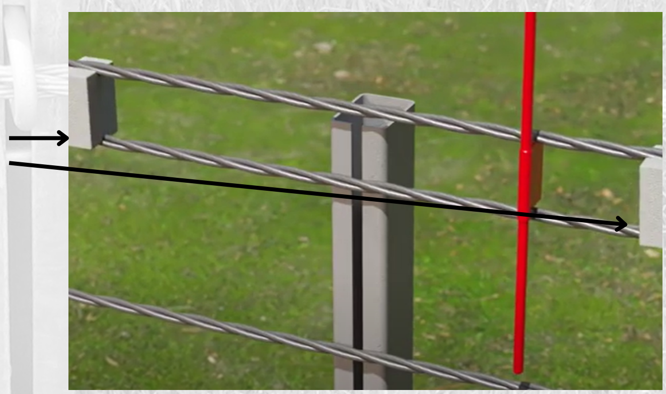
- Individual strands of cable should be in the grooves of the wedge and bundles should still be round.

SYSTEM REPAIR

1) When a portion of the system has been damaged, begin by removing the damaged post and replace with new posts.

2) Make sure that all the cables are on the correct sides of the posts. Make sure that the correct cable is on the top. The top cable should go through the hairpin on adjacent posts and cable should not twist.

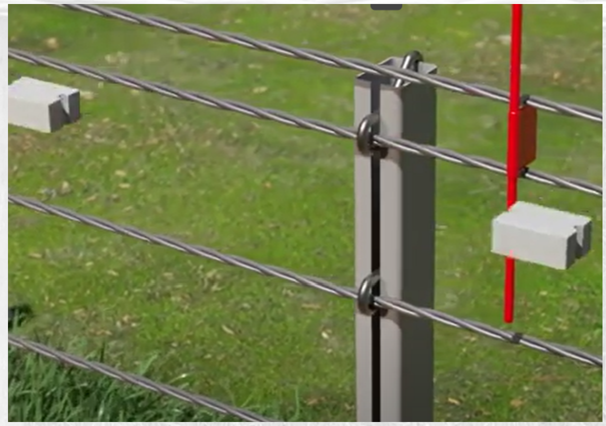
3) Insert the cable separator tool between the top two cables. Rotate the separator tool and insert a separator block on either side of the post, then remove the separator tool, leaving the blocks in place.



4) Install a hairpin by inserting the base of the hairpin into the post. Rotate the hairpin until the cables are in loops of the hairpin and the hairpin is in contact with the back of the post. Slide hairpins and cables up the post keeping the back leg of the hairpin in contact with the back of the post until the back leg of the hairpin goes over the post.

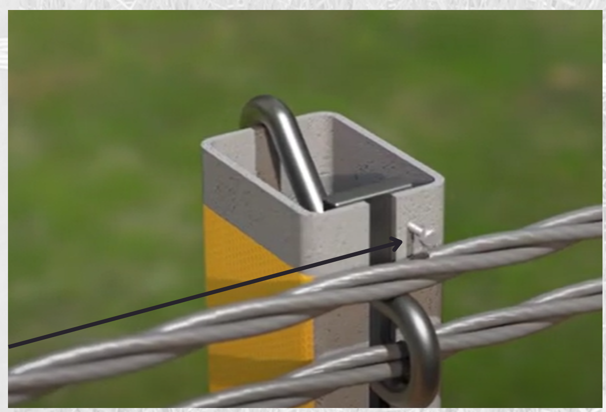
SYSTEM REPAIR
(CON'T)

5) Reinsert the separator tool between the top two cables, rotate the separator tool so the blocks can be removed. The separator tool can then be removed.



6) Insert the lock plate as shown and attach the delineation if required on this post.

7) If the cable height needs to be adjusted, use a self-drilling, self-tapping screw to hold the 3 cables in the hairpin at the correct height.



SYSTEM REPAIR
(CON'T)

8) Repeat the process for the remaining damaged posts. Once the system has been repaired, use a tension meter to check and record the tension of all cables and adjust the tension if necessary.

CRITICAL POINTS

- Hairpin & lockplate installed at every post.
- The 3 cables in the hairpin should be at the correct height when measured at the post.
- Use #12 x 3/4" self-drilling, self-tapping screws to hold posts & hardware to ensure cables are at the correct height.
- Delineation installed per project specification.
- Tension for all cables is within an acceptable range and recorded. Refer to the Adjusting Cable Tension video & Tensioning tab on the app or the tensioning chart in the Cable Distribution section of the manual.

CONTACT US

Technical & Sales Support

Gibraltar Cable Barrier Systems
1208 Houston Clinton Dr.
Burnet, TX 78611
(833) 715-0810 (toll-free)
(512) 715-0808 (office)
(512) 715-0811 (fax)
info@gibraltarglobal.com

Installation videos available at:
https://gibraltarglobal.com
and on the
Gibraltar Global app.

Available on the App Store

GET IT ON Google Play