U.S. Department
of Transportation
Federal Highway
Administration

400 Seventh St., S.W.
Washington, D.C. 20590

June 13, 2005

In Reply Refer To: HSA-10/B-137

TL 3

Mr. Bill Neusch, President
Gibraltar
320 Southland Road
Burnet, Texas 78611

Dear Mr. Neusch:

In your May 30 letter to Mr. Richard Powers of my staff, you requested the Federal Highway Administration (FHWA) acceptance of a high-tension, 3-strand cable barrier system. Copies of a May 26 report prepared by Karco Engineering and entitled "Crash Test Report for Gibraltar Tested to National Cooperative Highway Research Program (NCHRP) Report 350 Recommendations for test level 3-10 and 3-11 Cable Barrier System" and digital videos of the two tests were also submitted.

Your cable barrier system consists of three ¾-inch 3 X 7 prestretched, post-tensioned galvanized steel cables supported by steel C-posts 3.25 x 2.5 x 0.15-inches thick and 4-ft long, set in HSS 4 x 3 x 3/16 sockets. These sockets were 15-inches deep and placed in reinforced concrete footings 42-inches deep and 12-inches in diameter. Post spacing was 15 feet on centers. The posts were installed on alternate sides of the 3 cables that are held in place by a 7/16-inch diameter x 24-inch long galvanized steel hairpin and lock plate, with which the bottom, middle, and top cable heights are set and held in place at above-ground heights of 20 inches, 25 inches and 30 inches, respectively. These details for the line posts are shown in Enclosure 1. This enclosure also includes drawings of the terminal you developed for use with the Gibraltar Cable Barrier, which will be addressed in a separate acceptance letter in the immediate future. The barrier test installation was 200 feet long and each cable was tensioned to 4800 lbs. prior to the tests.

The NCHRP Report 350 tests 3-10 and 3-11 were both successfully conducted and the summary results of each are shown in Enclosure 2. Dynamic deflection was reported to be 8.5 feet. Based on the test results, the Gibraltar Cable Barrier may be considered an NCHRP Report 350 traffic barrier at test level 3 as a median barrier when the posts are set an alternate sides of the cables or as a roadside barrier when the cables are all on the traffic side of the C-posts.

You also asked about the acceptability of an alternative post embedment detail and the effect additional tension in the cables might have on the dynamic deflection of your barrier. Regarding post embedment details, a 30-inch deep reinforced concrete footing can be used when a mowing strip is used under the barrier. While longer posts embedded directly into the ground would almost certainly work, other factors such as post type and spacing, the use of soil plates, soil conditions, the distance between adjacent terminals or anchors, and the method used to connect the cables to the posts will affect the deflection distance and there is currently no way to predict that deflection with any degree of confidence. Similarly, increasing the cable tension will intuitively decrease deflection, but any such decrease cannot be readily quantified as it, too, is dependent on the factors listed above. To determine the design deflections for alternative post designs or post spacing, testing would need to be done. Design deflections for longitudinal barriers are only a reasonable approximation of what may be seen in the field. Because they are the observed results of a single test, actual deflections for any specific barrier can be much more or much less, depending on the size, speed, and impact angle of the vehicle that strikes it. In locations where deflection is a critical design element, a rigid concrete barrier would be a more logical choice than a flexible or semi-flexible barrier type.

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

- Our acceptance is limited to the crashworthiness characteristics of the tested device and does not cover its structural features, durability, or maintenance characteristics.
- Any design or material changes that may adversely affect the crashworthiness of the barrier will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the barrier being marketed is significantly different from the version that was crash tested, it reserves the right to modify or revoke its acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance, and that they will meet the crashworthiness requirements of the FHWA and the NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance, designated as number B-137 shall not be reproduced except in full. This letter, and the test documentation upon which this letter is based, is public information. All such letters and documentation may be reviewed at our office upon request.
- The Gibraltar Cable Barrier includes patented components and is considered proprietary. When proprietary devices are *specified by a highway agency* for use on Federal-aid projects, except exempt, non-NHS projects, they: (a) must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with existing highway facilities or that

no equally suitable alternative exists or; (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.

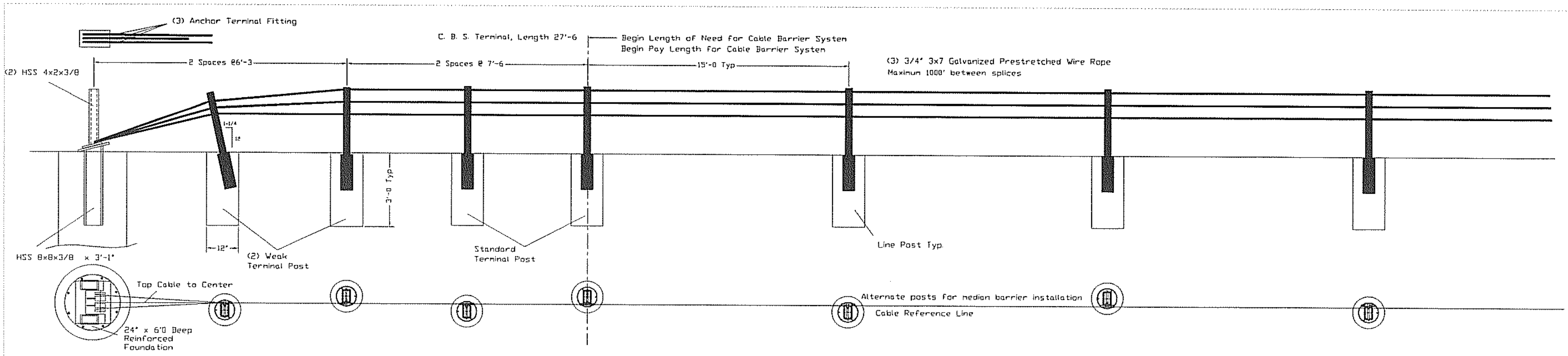
Sincerely yours,

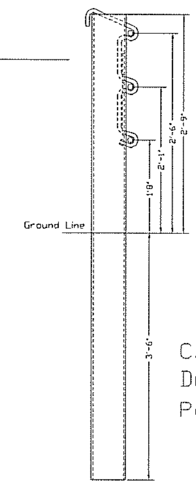
/original signed by/

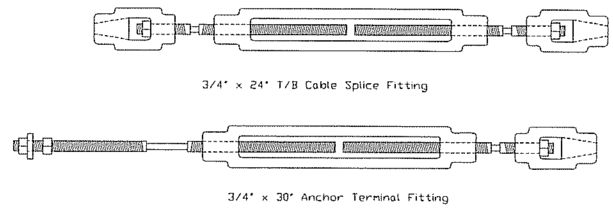
John R. Baxter, P.E.
Director, Office of Safety Design
Office of Safety

2 Enclosures

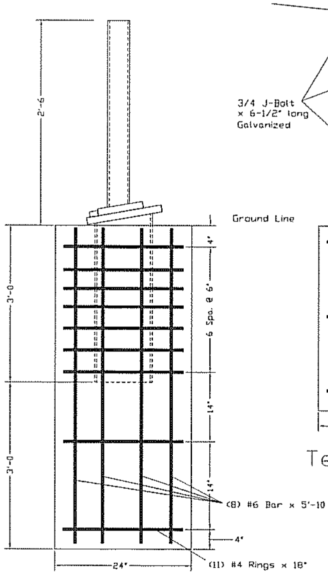
FHWA:HSA-10:DPowers:tb:x61320:6/13/05
File: h://directory folder/dpowers/B137(GibraltarWR)
cc: HSA-10 (Reader, HSA-1; Chron File, HSA-10;
D.Powers, HSA-10)

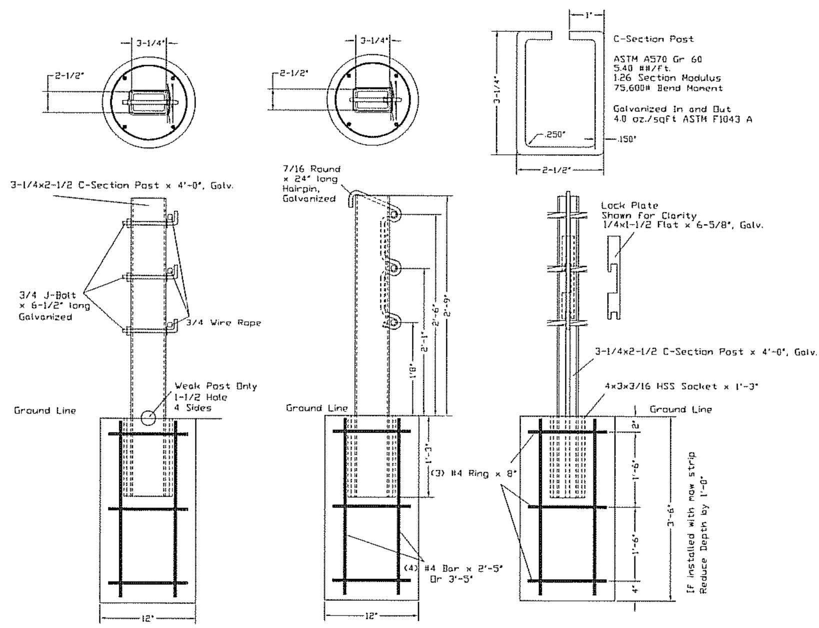






Cable Release Anchor Post





Terminal Post

Line Post

GENERAL NOTES

1. For additional information contact Gibraltar at 1-800-495-8957.
2. All concrete shall be Class C. All posts shall be socketed design unless otherwise specified.
3. The Cable Barrier System is designed for bi-directional traffic flow. If installed for traffic in one direction install cables on traffic side of posts.
4. The Cable Barrier System shall be installed on median shoulders or on depressed medians with slopes of 6:1 or flatter without obstructions, depressions, etc. that may influence trajectory of an errant vehicle.
5. See the Texas MUTCD for proper delineation.

Cable	Tension
-10F	9122
0	8688
10	8274
20	7954
30	7419
40	7001
50	6586
60	6151
70	5728
80	5303
90	4878
100	4455
110	4030

Date 6/10/05		
Drawn by DM		
Issued For Construction		
Approver	Date	

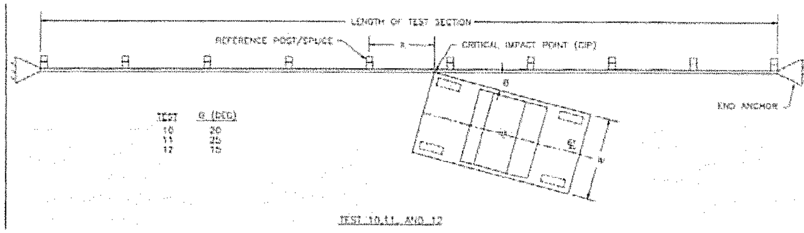
Gibraltar 320 Southland Road Burnet, Texas 78611

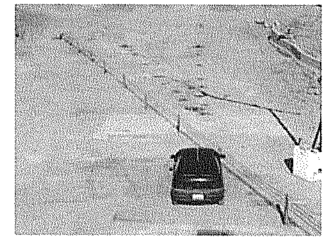
Cable Barrier System

1 May 2005

DATA SHEET NO. 3

SUMMARY OF RESULTS FOR TEST NO. 3-10

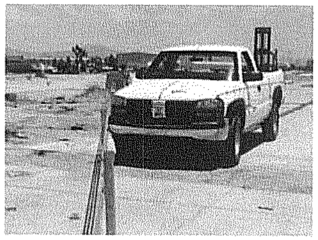



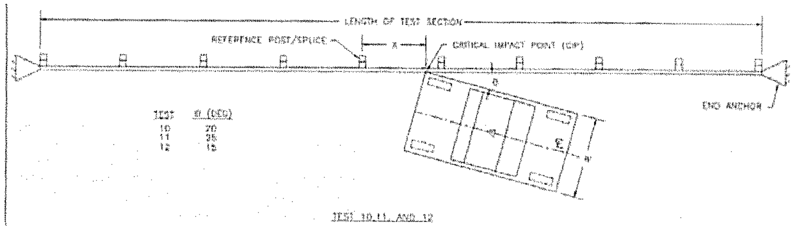


GENERAL INFORMATION		OCCUPANT RISK VALUES	
TEST AGENCY	KARCO ENGINEERING	IMPACT VELOCITY (m/sec)	
TEST NO.	3-10	X-DIRECTION	2.4
DATE	05/26/05	Y-DIRECTION	3.7
TEST ARTICLE		THIV (optional)	N/A
TYPE	LONGITUDINAL FENCE BARRIER UNIT	RIDEDOWN ACCELERATION (g's)	
INSTALLATION LENGTH (m)	N/A	X-DIRECTION	-6.2
SIZE AND/OR DIMENSION OF KEY ELEMENTS	200 ft LON	Y-DIRECTION	-7.1
SOIL TYPE AND CONDITION	CONCRETE	PHD (optional)	N/A
TEST VEHICLE	820C	ASI (optional)	0.66
TYPE	PRODUCTION	TEST ARTICLE DEFLECTIONS (m)	N/A
DESIGNATION	3-10	DYNAMIC	762 mm(2.5 ft)
MODEL	CHEVROLET METRO 2-DOOR	PERMANENT	N/A
MASS (CURB)	807 Kg (1780 lbs)	VEHICLE DAMAGE	
MASS (TEST INERTIAL)	827 Kg (1823 lbs)	EXTERIOR	
DUMMY(s) MASS	75 kg (165 lbs.)	VDS	1FR1
GROSS STATIC WEIGHT	895 Kg (1974 lbs)	CDC	01RDEN2
IMPACT CONDITIONS		INTERIOR	
SPEED (km/h)	100.2 (62.9 mph)	OCDI	FS0000000
ANGLE (Deg.)	20		
IMPACT SEVERITY (kJ)	41.3	POST IMPACT VEHICULAR BEHAVIOR	
EXIT CONDITIONS		MAXIMUM ROLL ANGLE (Deg.)	-32.7
SPEED (km/h)	79 (49.2 mph)	MAXIMUM PITCH ANGLE (Deg.)	-31.5
ANGLE (Deg.)	0	MAXIMUM YAW ANGLE (Deg.)	-18.4

DATA SHEET NO. 3

SUMMARY OF RESULTS FOR TEST NO. 3-11





GENERAL INFORMATION		OCCUPANT RISK VALUES	
TEST AGENCY	KARCO ENGINEERING	IMPACT VELOCITY (m/sec)	
TEST NO.	3-11	X-DIRECTION	3.6
DATE	5/26/05	Y-DIRECTION	3.3
TEST ARTICLE		THIV (optional)	N/A
TYPE	LONGITUDINAL FENCE BARRIER UNIT	RIDEDOWN ACCELERATION (g's)	
INSTALLATION LENGTH (m)	N/A	X-DIRECTION	3.7
SIZE AND/OR DIMENSION OF KEY ELEMENTS		Y-DIRECTION	2.9
SOIL TYPE AND CONDITION	CONCRETE	PHD (optional)	N/A
TEST VEHICLE	2000P	ASI (optional)	0.33
TYPE	PRODUCTION	TEST ARTICLE DEFLECTIONS (m)	N/A
DESIGNATION	3-11	DYNAMIC	2.62 m (8.6 ft)
MODEL	GMC SIERRA 2-DOOR TRUCK	PERMANENT	N/A
MASS (CURB)	2244 Kg (4948 lbs)	VEHICLE DAMAGE	
MASS (TEST INERTIAL)	2065 Kg (4552 lbs)	EXTERIOR	
DUMMY(s) MASS	N/A	VDS	1FR1
GROSS STATIC WEIGHT	2065 Kg (4552 lbs)	CDC	01RDEN2
IMPACT CONDITIONS		INTERIOR	
SPEED (km/h)	102.4 km/h (63.7 mph)	OCDI	FS0000000
ANGLE (Deg.)	25		
IMPACT SEVERITY (kJ)	149.2	POST IMPACT VEHICULAR BEHAVIOR	
EXIT CONDITIONS		MAXIMUM ROLL ANGLE (Deg.)	-35.5
SPEED (km/h)	48 (29.8 mph)	MAXIMUM PITCH ANGLE (Deg.)	-62.2
ANGLE (Deg.)	N/A	MAXIMUM YAW ANGLE (Deg.)	-4.5

U.S. Department
of Transportation
Federal Highway Administration

April 3, 2006

400 Seventh St., S.W.
Washington, D.C. 20590

In Reply Refer To: HSA-10/B-137B

Mr. Bill Neusch
President
Gibraltar
320 Southland Road
Burnet, Texas 78611

VARIABLE POST SPACING

Dear Mr. Neusch:

In your March 2, 2006, letter to Mr. Richard Powers of my staff, you provided summary information on two additional tests you ran on your test level 4 (TL-4) Gibraltar cable barrier system and requested the Federal Highway Administration's (FHWA) acknowledgment and acceptance of the test results. On March 9, 2006, you sent him complete copies of the January 6, 2006, reports prepared by Karco Engineering, LLC (Test Report Nos. TR-P26021-01-A and TR-P26028-01-B) and digital videos that documented the results of these tests. Both tests were run on your TL-4 design in which the cables are 20, 30, and 39 inches above the ground. The support posts were C-posts 3.25 inches by 2.5 inches by 0.15 inches by 4.9-feet long. Each post was set in a 15-inch deep socket placed in a 42-inch deep by 12-inch diameter reinforced concrete footing. The shape and the dimensions of the steel "hairpin" and lock plate that hold the cables in place were slightly modified from your earlier design and are shown in Enclosure 1. For both tests, the total installation length was 305 feet and the cables were tensioned to 5700 pounds.

For the first test, the line posts were set on 10-foot centers and the reported dynamic deflection was 6.8 feet. For the second test, the posts were spaced on 30-foot centers, resulting in 9.3 feet of deflection. The summary sheets for both of these tests are shown as Enclosure 2. I concur with the test agency's assessment that both tests met the appropriate evaluation criteria for National Cooperative Highway Research Program Report 350 test 3-11, and either design may be used on the National Highway System when such use is acceptable to the contracting agency. In your March 29, 2006, follow-up letter, you requested confirmation that either 6.25-foot long posts (for TL-3) or 7-foot long C-posts (for TL-4), driven directly into the soil to a depth of 42-inches, could be used as an alternative to the tested socketed posts. Since the longer posts were successfully used in the June 20, 2005, TL-3 test referenced below and in your earlier TL-4 test, I agree that either the driven or the socketed post design may be used.

Based on a straight-line interpolation of the dynamic deflection distances noted above, you also requested FHWA concurrence in assumed deflections based on intermediate post spacings, i.e., post spacings *between* 10 feet and 30 feet. In reviewing our earlier acceptance letters for the

Gibraltar system, we noted that for your original TL-3 design with a 15-foot post spacing, the reported dynamic deflection was approximately 8.5 feet. A test conducted for you by Karco on June 20, 2005, on a slightly modified design resulted in a reduced dynamic deflection of 7.75 feet. Because both test installations were shorter in those tests (only 200 feet) and the tension in the cables was less (4800 lbs.), a direct comparison with your two recent tests cannot be made. However, the predicted deflections based on a straight-line interpolation between the 10- and 30-foot post spacing deflections appear reasonable. Thus, with your TL-4 design, the assumed deflections with a 12-foot post spacing would be approximately 7 feet, those with a 20-foot spacing would be approximately 8 feet, and those with a 30-foot spacing would be approximately 9 feet.

As noted in my original acceptance letter B-137, dated June 13, 2005, dynamic deflection distances based on a single standardized test are not precise and represent only an approximation of what is likely to be seen in the field. Many deflections will be less, but some will be significantly greater, depending on actual crash conditions. Assuming test deflections are accurate to the nearest inch and designing a barrier installation accordingly presumes a degree of precision that simply does not exist. To increase the factor of safety afforded the motoring public, the available deflection distance should exceed the design deflection distance for a flexible or semi-flexible barrier system whenever practicable.

Sincerely yours,

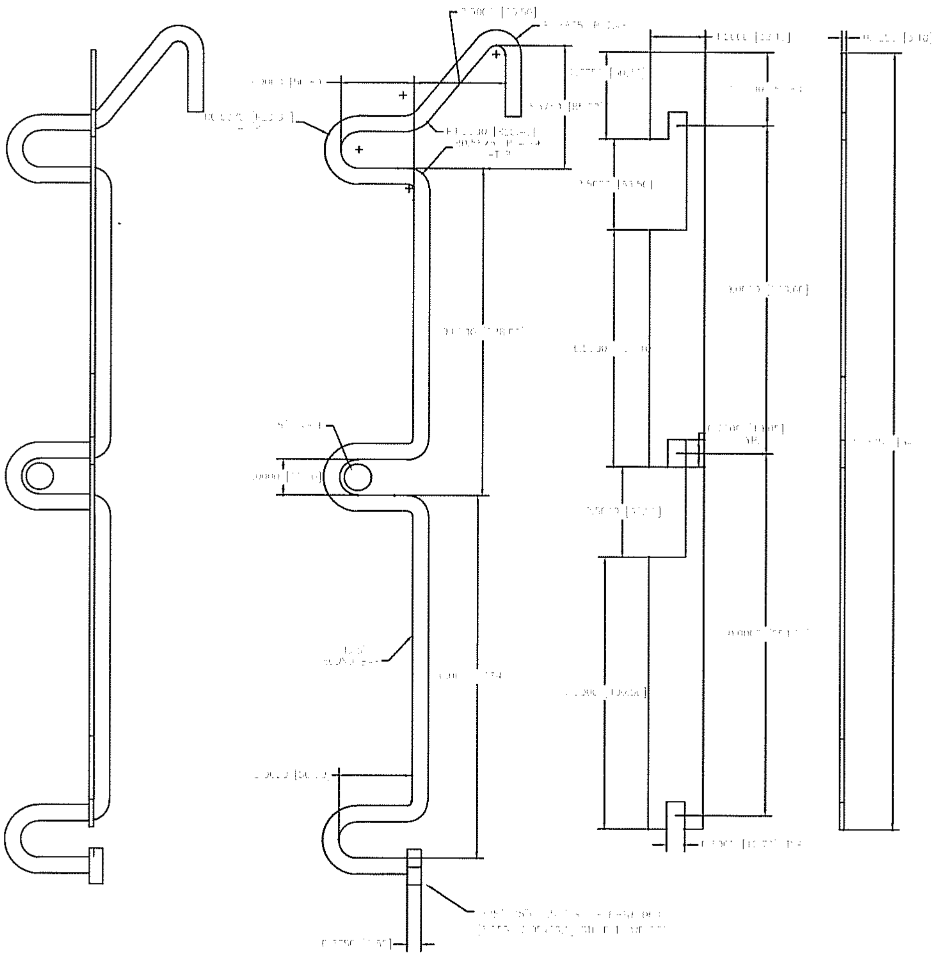
/original signed by/

John R. Baxter, P.E.
Director, Office of Safety Design
Office of Safety

2 Enclosures

PART # 4-L29

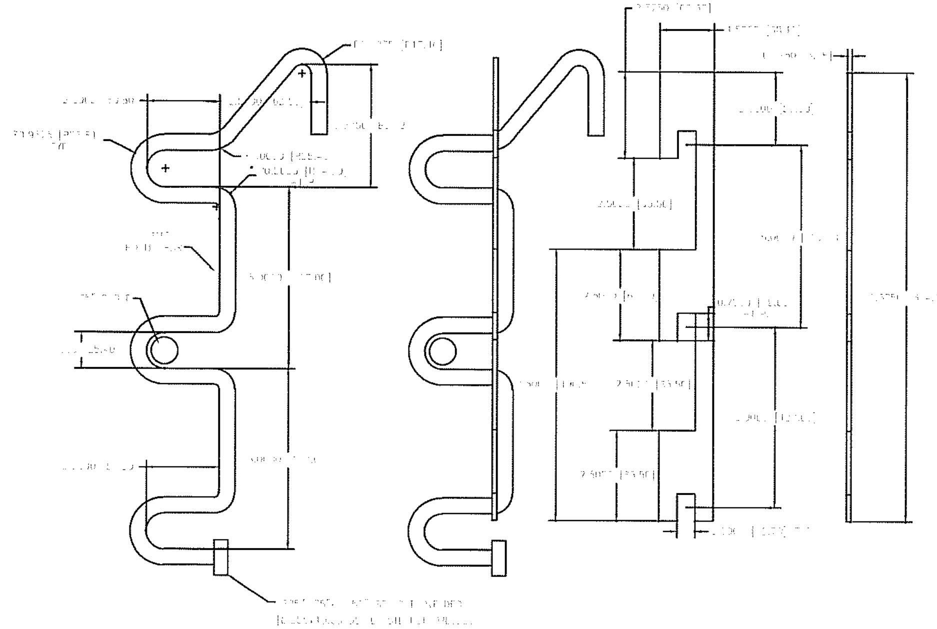
PART # 4-L30



TL-4 HAIRPIN AND LOCKPLATE

PART # 3-L03

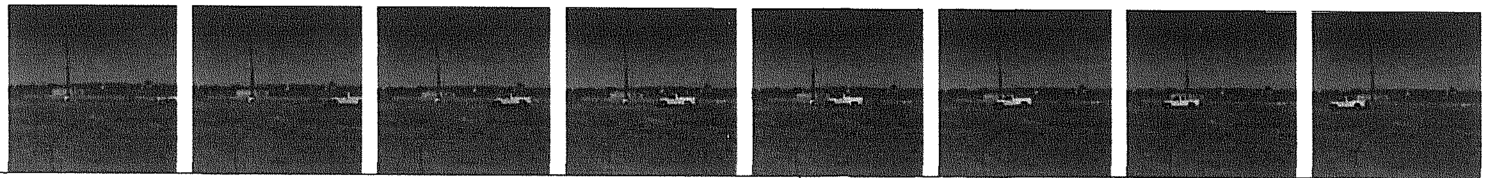
PART # 3-L10



TL-3HAIPPIN AND LOCKPLATE

DATA SHEET NO. 4

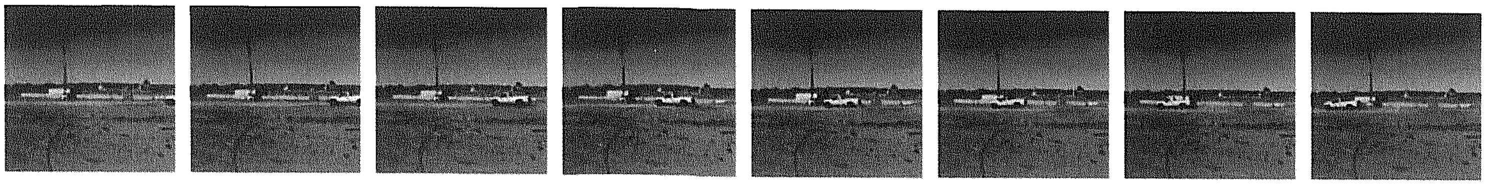
SUMMARY OF RESULTS FOR TEST NO. 3-11



GENERAL INFORMATION		OCCUPANT RISK VALUES	
TEST AGENCY	KARCO ENGINEERING	IMPACT VELOCITY (m/sec)	
TEST NO.	3-11	X-DIRECTION	4.0
DATE	01/06/06	Y-DIRECTION	6.8
TEST ARTICLE		THIV (optional)	N/A
TYPE	Gibraltar TL-4 Cable Barrier System	RIDEDOWN ACCELERATION (g's)	
INSTALLATION LENGTH (m)	93 m(305 ft)	X-DIRECTION	-2.3
SIZE AND/OR DIMENSION OF KEY ELEMENTS	¾ in 3 X 7 cable on 10 ft post spacings	Y-DIRECTION	-5.3
SOIL TYPE AND CONDITION	CONCRETE	PHD (optional)	N/A
TEST VEHICLE	2000P	ASI (optional)	0.44
TYPE	PRODUCTION	TEST ARTICLE DEFLECTIONS (m)	N/A
DESIGNATION	3-11	DYNAMIC	2 m (6.8 ft)
MODEL	Chevrolet 2500 Pick-Up Truck	PERMANENT	N/A
MASS (CURB)	2138 kg (4712 lbs)	VEHICLE DAMAGE	
MASS (TEST INERTIAL)	2020 kg (4452 lbs)	EXTERIOR	
DUMMY(s) MASS	N/A	VDS	1FR1
GROSS STATIC WEIGHT	2020 kg (4452 lbs)	CDC	01RDEN2
IMPACT CONDITIONS		INTERIOR	
SPEED (km/h)	99.85 km/h (62.06 mph)	OCDI	FS0000000
ANGLE (Deg.)	25		
IMPACT SEVERITY (kJ)	140	POST-IMPACT VEHICULAR BEHAVIOR	
EXIT CONDITIONS		MAXIMUM ROLL ANGLE (Deg.)	-33.0
SPEED (km/h)	83.3 km/h @1000 ms	MAXIMUM YAW ANGLE (Deg.)	-12.7
ANGLE (Deg.)	<10	MAXIMUM PITCH ANGLE (Deg.)	2.8

DATA SHEET NO. 4

SUMMARY OF RESULTS FOR TEST NO. 3-11



GENERAL INFORMATION		OCCUPANT RISK VALUES	
TEST AGENCY	KARCO ENGINEERING	IMPACT VELOCITY (m/sec)	
TEST NO.	3-11	X-DIRECTION	4.0
DATE	01/06/06	Y-DIRECTION	6.8
TEST ARTICLE		THIV (optional)	
TYPE	Gibraltar TL-4 Cable Barrier System	RIDEDOWN ACCELERATION (g's)	
INSTALLATION LENGTH (m)	93 m(305 ft)	X-DIRECTION	-2.3
SIZE AND/OR DIMENSION OF KEY ELEMENTS	¾ in 3 X 7 cable on 30 ft post spacings	Y-DIRECTION	-5.3
SOIL TYPE AND CONDITION	CONCRETE	PHD (optional)	
TEST VEHICLE	2000P	ASI (optional)	0.44
TYPE	PRODUCTION	TEST ARTICLE DEFLECTIONS (m)	N/A
DESIGNATION	3-11	DYNAMIC	2.8 m (9.3 ft)
MODEL	Chevrolet 2500 Pick-Up Truck	PERMANENT	N/A
MASS (CURB)	2138 kg (4712 lbs)	VEHICLE DAMAGE	
MASS (TEST INERTIAL)	2020 kg (4452 lbs)	EXTERIOR	
DUMMY(s) MASS		VDS	1FR1
GROSS STATIC WEIGHT	2020 kg (4452 lbs)	CDC	01RDEN2
IMPACT CONDITIONS		INTERIOR	
SPEED (km/h)	101.5 km/h (62.80 mph)	OCDI	FS0000000
ANGLE (Deg.)	25		
IMPACT SEVERITY (kJ)	140	POST IMPACT VEHICULAR BEHAVIOR	
EXIT CONDITIONS		MAXIMUM ROLL ANGLE (Deg.)	-33.0
SPEED (km/h)	54.9 km/h @ 1500ms	MAXIMUM YAW ANGLE (Deg.)	-12.7
ANGLE (Deg.)	<10	MAXIMUM PITCH ANGLE (Deg.)	2.8

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

October 27, 2006

400 Seventh St., S.W.
Washington, D.C. 20590

In Reply Refer To:
HSA-10

TL3 & TL4
DEFLECTION

Mr. Bill Neusch
President
Gibraltar
320 Southland Road
Burnet, TX 78611

Dear Mr. Neusch:

In your October 13, 2006, letter to Mr. Richard Powers of my staff, you requested formal acknowledgement that the design deflection distances shown in the Federal Highway Administration's April 3, 2006, acceptance letter B-137B for your 3-cable test level 4 (TL-4) barrier design can also be considered acceptable for your 3-cable TL-3 design. For the TL-4 design, these deflections with a 12-foot post spacing were approximately 7 feet, those with a 20-foot spacing were approximately 8 feet, and those with a 30-foot spacing were approximately 9 feet. Since both your TL-3 and TL-4 designs use three cables, albeit with a higher top cable height with the TL-4 design, it is reasonable to assume that design deflections for both systems will be similar under the same impact conditions. Therefore, the deflections noted above can also be applied to your TL-3 design.

As stated in my original acceptance letter B-137, dated June 13, 2005, and repeated here for emphasis, dynamic deflection distances based on standardized tests are not precise and represent only an approximation of what is likely to be seen in the field. Actual deflections depend on actual crash conditions such as vehicle type, impact speed, and roadway departure angle. To increase the factor of safety afforded the motoring public, the available deflection distance for any flexible or semi-flexible barrier system should exceed its design deflection distance whenever practicable.

Sincerely yours,

/original signed by/

John R. Baxter, P.E.
Director, Office of Safety Design
Office of Safety

U.S. Department
of Transportation
Federal Highway Administration

August 9, 2006

400 Seventh St., S.W.
Washington, D.C. 20590

In Reply Refer To: HSA-10

SOCKETS

Mr. Bill Neusch
Gibraltar
320 Southland Road
Burnet, Texas 786112

Dear Mr. Neusch:

In response to your e-mail request, please be advised it is the Federal Highway Administration's current position to consider driven posts and socketed posts set in concrete footings or driven steel sockets to be equivalent and, thus interchangeable when used in any configuration (i.e., post spacing) that was physically tested or at a spacing that lies between two spacings that were physically tested. In short, any post embedment type (i.e., driven posts, concrete-socketed posts, and driven steel tube socketed posts) for any post spacing that you have physically tested may be considered acceptable. The assumed design deflection for any alternative embedment design used would be the maximum deflection noted in any test with the same post spacing, even though a different embedment detail was used in the actual crash test. Based on tests run to date, there is some difference in deflection that can be attributed to embedment type, but it seems not to be significant, particularly since design deflections based on a single test are only a rough approximation of what will be seen in the field, given the potential disparity in actual crash conditions.

Since you have tested your Gibraltar cable system with posts set 15 inches into 42 deep concrete footings and also with posts driven directly into the ground to a 42-inch depth, I can agree that posts set 15 inches into a 3/16-inch thick 3"x 4" steel socket driven 42-inches deep would be expected to perform satisfactorily as well.

Sincerely yours,

/original signed by M.McDonough/

~for~

John R. Baxter, P.E.
Director, Office of Safety Design
Office of Safety

Celebrating 50 Years 1956 2006 Eisenhower Interstate System

BUCKLE UP AMERICA

U.S. Department
of Transportation
Federal Highway Administration

400 Seventh St., S.W.
Washington, D.C. 20590

June 23, 2005

In Reply Refer To: HSA-10/CC-92

Mr. Bill Neusch, President
Gibraltar
320 Southland Road
Burnet, Texas 78611

END TERMINALS

Dear Mr. Neusch:

In your June 7 letter to Mr. Richard Powers of my staff, you requested the Federal Highway Administration's acceptance of a cable barrier terminal designed for use with the Gibraltar Cable Barrier that was acknowledged to be a test level 3 (TL-3) barrier in my June 10 acceptance letter, B-137. With your letter, you submitted copies of crash test reports prepared by Karco Engineering and digital videos that documented the results of the crash tests that were conducted on the new terminal.

Your cable barrier terminal consists of a cable release anchor post and four terminal posts, the first of which is set 6'-3" beyond the anchor post, the second 6'-3" beyond the first, and the third and fourth on 7'-6" centers. These posts are then followed by standard line posts on 15-foot centers. The cable release anchor post is comprised of two HSS 2 x 4 x 3/8 steel posts welded to a ¾-inch thick steel base plate. This anchor post rests on a 1/2-inch thick base plate that is welded to an HSS 8 x 8 x 3/8 tube, 30-inches long, set in a 6-foot deep x 24-inch diameter reinforced concrete foundation. This anchor post is designed to pry the cable ends out of slots in the base plate when it is struck, thus releasing all cable tension and allowing a vehicle to pass over the terminal with a relatively stable trajectory. All terminal posts are 3.25 x 2.5 C-posts, like the line posts, but the cables are held in place by 3/4-in x 5.5-in long J-bolts rather than the steel hairpins and lock plates used on the line posts. The first terminal post is angled towards the cable release post as show in Enclosure 1 and the first two terminal posts have 1.5-in diameter holes on all four sides at the ground line. All posts beyond the anchor post are set in 42-in deep reinforced concrete footings. We noted that the anchor post design was modified during the testing sequence. Specifically, the original HSS 8 x 8 x 3/8 steel anchor post was replaced with the anchor post described above for tests 3-30 and 3-34 because the larger post lodged under the impacting vehicle in earlier tests, causing the small car to overturn. The original post remained intact in the length-of-need test 3-35 and its release mechanism remained unchanged. Likewise, the larger post yielded satisfactorily in the reverse-direction test 3-39. Thus, I agreed that neither test needed to be conducted again with the smaller anchor post.

The National Cooperative Highway Research Program (NCHRP) Report 350 tests 3-30, 3-32, 3-35, and 3-39 were successfully conducted and the summary results of each are shown in Enclosure 2. We agreed that, upon successful results of tests 3-30 and 3-32, tests 3-31 and 3-33 could be waived for your specific terminal design. Therefore, based on the test results, the Gibraltar Cable Barrier Terminal, as described herein, may be considered an NCHRP Report 350 terminal at TL-3. In test 3-35, the pickup truck impacted the terminal at post 4 and was contained and redirected. Thus, the beginning length of need for the Gibraltar terminal is at the last terminal post, 27.5 feet downstream from the anchor post.

We noted that in test 3-30, the impacting vehicle rolled after exiting the test installation. After reviewing the film, we concluded that the vehicle had regained stability as it rode along the cable and that the rollover was the result of its wheels tripping in the loose soil at the test site rather than instability caused directly by impact into the terminal. However, this result and the post-impact trajectory seen in test 3-32 emphasize the fact that your terminal, like all cable terminals tested to date, has virtually no attenuating capability. Thus, vehicles impacting the end will normally continue a significant distance behind and beyond the barrier and are then likely to encounter non-traversable terrain or other roadside hazards or encroach into opposing traffic lanes when the barrier is used in a median. Designers must take this fact into account when selecting an optimum location for terminals in the field.

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

- Our acceptance is limited to the crashworthiness characteristics of the tested device and does not cover its structural features, durability, or maintenance characteristics.
- Any design or material changes that may adversely affect the crashworthiness of the barrier will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the barrier being marketed is significantly different from the version that was crash tested, it reserves the right to modify or revoke its acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance, and that they will meet the crashworthiness requirements of the FHWA and the NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance, designated as number CC-92 shall not be reproduced except in full. This letter, and the test documentation upon which this letter is based, is public information. All such letters and documentation may be reviewed at our office upon request.
- The Gibraltar Cable Barrier Terminal includes patented components and is considered proprietary. When proprietary devices are *specified by a highway agency* for use on

Federal-aid projects, except exempt, non-NHS projects, they: (a) must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway

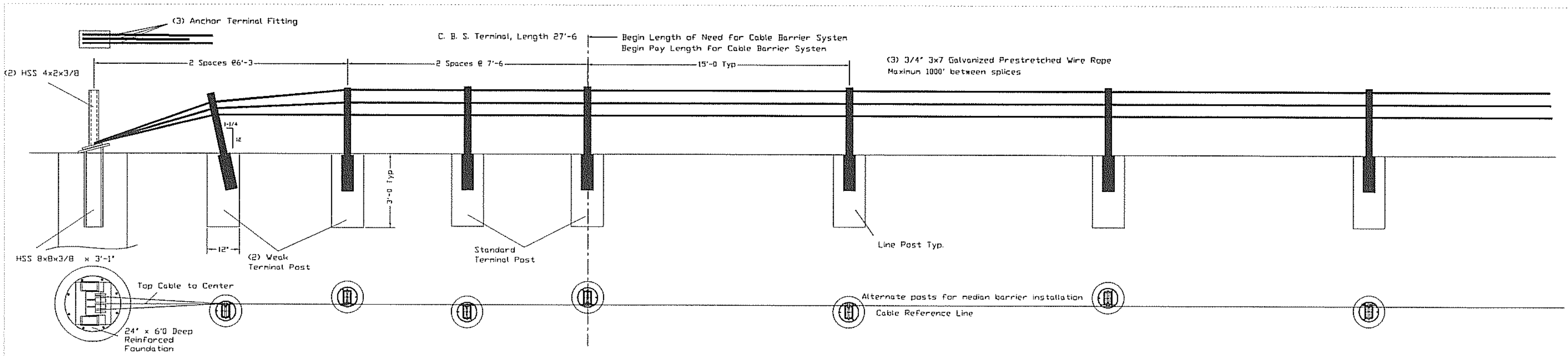
agency must certify that they are essential for synchronization with existing highway facilities or that no equally suitable alternative exists or; (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.

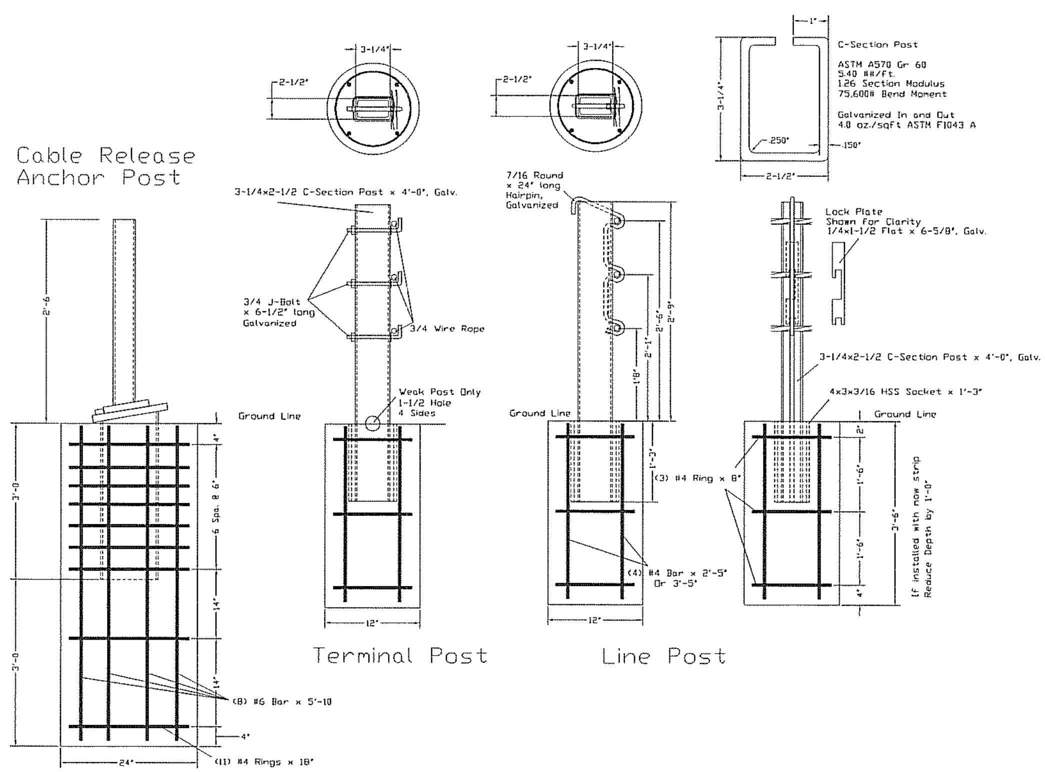
Sincerely yours,

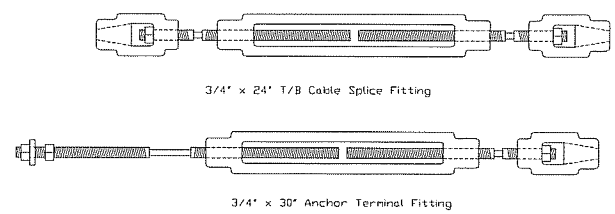
/original signed by/

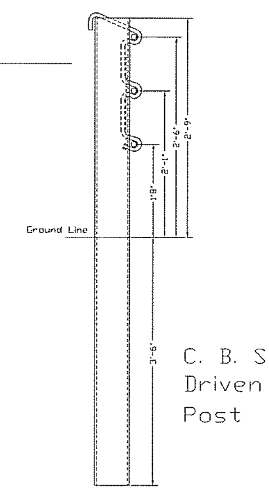
John R. Baxter, P.E.
Director, Office of Safety Design
Office of Safety

2 Enclosures









GENERAL NOTES

1. For additional information contact Gibraltar at 1-800-495-8957.
2. All concrete shall be Class C. All posts shall be socketed design unless otherwise specified.
3. The Cable Barrier System is designed for bi-directional traffic flow. If installed for traffic in one direction install cables on traffic side of posts.
4. The Cable Barrier System shall be installed on median shoulders or on depressed medians with slopes of 6:1 or flatter without obstructions, depressions, etc. that may influence trajectory of an errant vehicle.
5. See the Texas MUTCD for proper delineation.

Cable	Tension
-10F	9122
0	8688
10	8274
20	7954
30	7419
40	7001
50	6586
60	6151
70	5728
80	5303
90	4878
100	4455
110	4030

Date 6/10/05	
Drawn by DM	
Issued For Construction	
Approver	Date

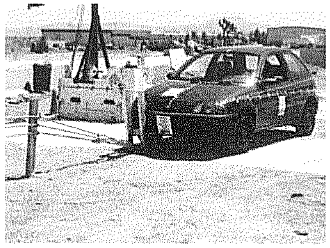
Gibraltar 320 Southland Road Burnet, Texas 78611

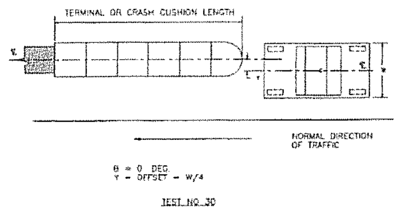
Cable Barrier System

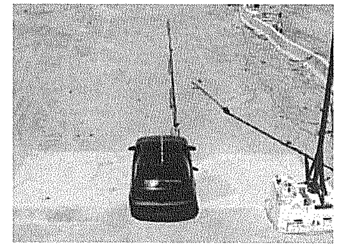
1 May 2005

DATA SHEET NO. 3

SUMMARY OF RESULTS FOR TEST NO. 3-30



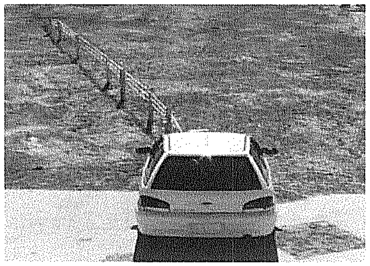
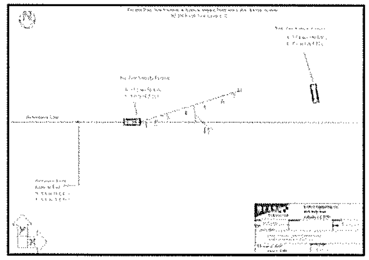




GENERAL INFORMATION		OCCUPANT RISK VALUES	
TEST AGENCY	KARCO ENGINEERING, LLC	IMPACT VELOCITY (m/sec)	
TEST NO.	3-30	X-DIRECTION	4.4
DATE	06/01/05	Y-DIRECTION	0.1
TEST ARTICLE		THIV (optional)	
TYPE	CABLE BARRIER SYSTEM	RIDEDOWN ACCELERATION (g's)	
INSTALLATAION LENGTH (m)		X-DIRECTION	-1.9
SIZE AND/OR DIMENSION OF KEY ELEMENTS		Y-DIRECTION	1.5
SOIL TYPE AND CONDITION	CONCRETE	PHD (optional)	
TEST VEHICLE	820C	ASI (optional)	0.35
TYPE	PRODUCTION	TEST ARTICLE DEFLECTIONS (m)	
DESIGNATION	3-30	DYNAMIC LATERAL	
MODEL	1998 Chevrolet Metro	LONGITUDINAL	
MASS (CURB)	807 kg (1780 lbs)	PERMANENT	
MASS (TEST INERTIAL)	804 kg (1772 lbs)	VEHICLE DAMAGE	
DUMMY(s) MASS	75 Kg.	EXTERIOR	
GROSS STATIC WEIGHT	878 kg (1936 lb)	VDS	1FR1
IMPACT CONDITIONS		CDC	12RDEN2
SPEED (km/h)	100.2 (62.3 mph)	INTERIOR	
ANGLE (Deg.)	0.0	OCDI	FS0000000
IMPACT SEVERITY (kJ)	311.8	POST IMPACT VEHICULAR BEHAVIOR	
EXIT CONDITIONS		MAXIMUM ROLL ANGLE (Deg.)	21.9
SPEED (km/h)	79.2 (49.2 mph)	MAXIMUM PITCH ANGLE (Deg.)	-12.8
ANGLE (Deg.)		MAXIMUM YAW ANGLE (Deg.)	8.9

DATA SHEET NO. 3

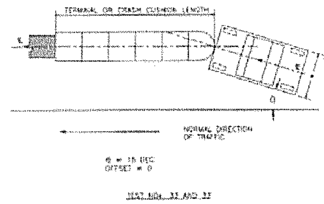
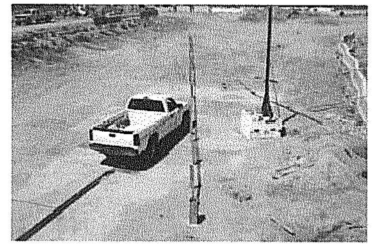
SUMMARY OF RESULTS FOR TEST NO. 3-32

GENERAL INFORMATION		OCCUPANT RISK VALUES	
TEST AGENCY	KARCO ENGINEERING, LLC	IMPACT VELOCITY (m/sec)	
TEST NO.	3-32	X-DIRECTION	3.5
DATE	5/31/05	Y-DIRECTION	0.2
TEST ARTICLE		THIV (optional)	
TYPE	LONGITUDINAL FENCE BARRIER UNIT	RIDEDOWN ACCELERATION (g's)	
INSTALLATAION LENGTH (m)		X-DIRECTION	-1.2
SIZE AND/OR DIMENSION OF KEY ELEMENTS		Y-DIRECTION	-1.6
SOIL TYPE AND CONDITION	CONCRETE	PHD (optional)	
TEST VEHICLE	820C	ASI (optional)	0.5
TYPE	PRODUCTION	TEST ARTICLE DEFLECTIONS (m)	
DESIGNATION	3-32	DYNAMIC LATERAL	
MODEL	2000 Chevrolet Metro	LONGITUDINAL	
MASS (CURB)	848 kg (1870 lb)	PERMANENT	
MASS (TEST INERTIAL)	844 kg (1860 lb.)	VEHICLE DAMAGE	
DUMMY(s) MASS	75 Kg.	EXTERIOR	
GROSS STATIC WEIGHT	919 kg (2026 lb.)	VDS	1FR1
IMPACT CONDITIONS		CDC	01RDEN2
SPEED (km/h)	103.2 (64.1 mph)	INTERIOR	
ANGLE (Deg.)	15.0	OCDI	FS0000000
IMPACT SEVERITY (kJ)	375.8	POST IMPACT VEHICULAR BEHAVIOR	
EXIT CONDITIONS		MAXIMUM ROLL ANGLE (Deg.)	-27.1
SPEED (km/h)	88.9 (55.2 mph)	MAXIMUM PITCH ANGLE (Deg.)	-7.4
ANGLE (Deg.)		MAXIMUM YAW ANGLE (Deg.)	-19.2

DATA SHEET NO. 3

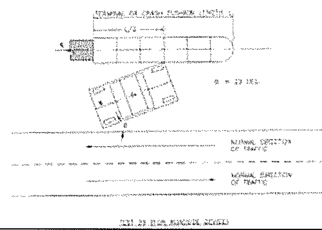
SUMMARY OF RESULTS FOR TEST NO. 3-35

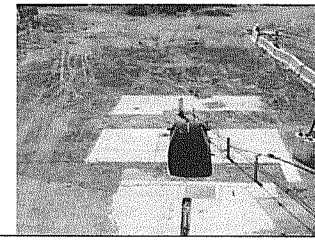




GENERAL INFORMATION		OCCUPANT RISK VALUES	
TEST AGENCY	KARCO ENGINEERING, LLC	IMPACT VELOCITY (m/sec)	
TEST NO.	3-35	X-DIRECTION	2.5
DATE	5/27/05	Y-DIRECTION	3.0
TEST ARTICLE		THIV (optional)	N/A
TYPE	CABLE BARRIER SYSTEM	RIDEDOWN ACCELERATION (g's)	
INSTALLATION LENGTH (m)	N/A	X-DIRECTION	-5.5
SIZE AND/OR DIMENSION OF KEY ELEMENTS		Y-DIRECTION	-5.3
SOIL TYPE AND CONDITION	CONCRETE	PHD (optional)	N/A
TEST VEHICLE	2000P	ASI (optional)	N/A
TYPE	PRODUCTION	TEST ARTICLE DEFLECTIONS (m)	
DESIGNATION	3-35	DYNAMIC	2 (6.5 ft)
MODEL	CHEVROLET 2-DOOR PICKUP	PERMANENT	N/A
MASS (CURB)	2033 Kg (4482 lbs)	VEHICLE DAMAGE	
MASS (TEST INERTIAL)	1987 Kg (4380 lbs)	EXTERIOR	
DUMMY(s) MASS	N/A	VDS	1FR1
GROSS STATIC WEIGHT	1987 Kg (4380 lbs)	CDC	01RDEN2
IMPACT CONDITIONS		INTERIOR	
SPEED (km/h)	99.95 (62.12 mph)	OCDI	FS0000000
ANGLE (Deg.)	20		
IMPACT SEVERITY (kJ)	89.6	POST IMPACT VEHICULAR BEHAVIOR	
EXIT CONDITIONS		MAXIMUM ROLL ANGLE (Deg.)	44.2
SPEED (km/h)	38 (23.7 mph)	MAXIMUM PITCH ANGLE (Deg.)	7.7
ANGLE (Deg.)	N/A	MAXIMUM YAW ANGLE (Deg.)	51.0

DATA SHEET NO. 3

SUMMARY OF RESULTS FOR TEST NO. 3-39 (Modified)





GENERAL INFORMATION		OCCUPANT RISK VALUES	
TEST AGENCY	KARCO ENGINEERING	IMPACT VELOCITY (m/sec)	
TEST NO.	3-39 (Modified)	X-DIRECTION	11.0
DATE	5/27/05	Y-DIRECTION	4.4
TEST ARTICLE		THIV (optional)	N/A
TYPE	CABLE BARRIER SYSTEM	RIDEDOWN ACCELERATION (g's)	
INSTALLATION LENGTH (m)	N/A	X-DIRECTION	-17.5
SIZE AND/OR DIMENSION OF KEY ELEMENTS		Y-DIRECTION	N/A
SOIL TYPE AND CONDITION	CONCRETE	PHD (optional)	N/A
TEST VEHICLE	820C	ASI (optional)	N/A
TYPE	PRODUCTION	TEST ARTICLE DEFLECTIONS (m)	N/A
DESIGNATION	3-39 (Modified)	DYNAMIC	N/A
MODEL	CHEVROLET METRO 2-DOOR	PERMANENT	N/A
MASS (CURB)	808 Kg (1780 lbs)	VEHICLE DAMAGE	
MASS (TEST INERTIAL)	803 Kg (1769 lbs)	EXTERIOR	
DUMMY(s) MASS	75 kg (165 lbs.)	VDS	1FR1
GROSS STATIC WEIGHT	873 Kg (1924 lbs)	CDC	01RDEN2
IMPACT CONDITIONS		INTERIOR	
SPEED (km/h)	98.9 (61.47 mph)	OCDI	FS0000000
ANGLE (Deg.)	20		
IMPACT SEVERITY (Kj)	38.6	POST IMPACT VEHICULAR BEHAVIOR	
EXIT CONDITIONS		MAXIMUM ROLL ANGLE (Deg.)	-53.9
SPEED (km/h)	0	MAXIMUM PITCH ANGLE (Deg.)	-60.5
ANGLE (Deg.)	0	MAXIMUM YAW ANGLE (Deg.)	-15.5