



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

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

January 29, 2010

In Reply Refer To:  
HSSD/CC-88D

Mr. John C. Durkos  
Vice President Technical Support and Marketing  
Road Systems, Inc.  
3616 Howard County Airport  
Big Spring, TX 79720

Dear Mr. Durkos:

This letter is in response to your request for the Federal Highway Administration's (FHWA) acceptance of two modified roadside safety devices for use on the National Highway System (NHS).

Name of devices:	TL-2 SKT and TL-2 FLEAT W-Beam Guardrail Terminals for the Midwest Guardrail System (MGS)
Type of device:	Midwest W-Beam Guardrail Terminals
Test Level:	NCHRP Report 350 Test Level 2
Testing conducted by:	N/A
Date of request:	May 29, 2009
Date acknowledged:	June 29, 2009

You requested that we find these devices acceptable for use on the NHS under the provisions of National Cooperative Highway Research Program (NCHRP) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features."

### **Requirements**

Roadside safety devices should meet the guidelines contained in the NCHRP Report 350 or the American Association of State Highway and Transportation Officials' "Manual for Assessing Safety Hardware." The FHWA Memorandum "Identifying Acceptable Highway Safety Features" of July 25, 1997, provides further guidance on crash testing requirements of longitudinal barriers.



## **Description**

The Sequential Kinking Terminal (SKT) and Flared Energy Absorbing Terminal (FLEAT) have been successfully crash tested and accepted by the FHWA:

Test Level 3 (TL-3) SKT and FLEAT terminals for the MGS are covered by the FHWA Acceptance Letters CC-88 dated March 8, 2005, and CC-88A dated June 1, 2008.

Test Level 2 (TL-2) SKT and FLEAT terminals for the standard metric height guardrail system are covered by the FHWA Acceptance Letters CC-46B dated May 21, 1999, for the TL-2 FLEAT terminal and CC-40A dated February 4, 2000, for the SKT terminal.

Enclosed for reference are drawings of your proposed TL-2 MGS SKT and TL-2 FLEAT steel post and wood post terminals. The designs of these TL-2 MGS terminals are essentially the same as the Accepted TL-3 MGS terminals except for the terminal length and number of breakaway posts. For the TL-2 SKT-MGS terminal, the length is reduced from 50 feet, 0 inches to 25 feet, 0 inches with fewer breakaway posts, i.e., for the TL-2 system, post #6 and beyond are now a standard line post. For the TL-2 FLEAT-MGS terminal the length of the straight flare is reduced from 37 feet, 6 inches to 25 feet, zero inches. The corresponding range of end-offset is reduced from 2 feet, 6 inches and 4 feet, 0 inches to 1 foot, 8 inches and 2 feet, 8 inches respectively. The TL-2 FLEAT-MGS terminal also has one fewer breakaway post, i.e., for the TL-2 system, post #6 is now a standard line post. Also, note that the layouts of the TL-2 MGS terminals are identical to those used for the approved TL-2 metric height terminals.

## **Analysis**

NCHRP Report 350 guidelines recommend a total of up to seven full-scale crash tests for gating guardrail terminals. It was your opinion that no additional full-scale crash tests are required to evaluate the safety performance of these proposed TL-2 MGS terminal designs. First, the layouts of the TL-2 MGS terminals are the same as those for the FHWA-accepted TL-2 metric height terminals. This tells us that the proposed TL-2 MGS terminals will also be able to manage the energy of the impacting vehicle as did the crash-tested systems. Second, the TL-2 MGS terminal designs are essentially the same as those of the approved TL-3 MGS terminal designs except for the shorter terminal length and fewer breakaway posts.

## **Findings**

The modified TL-2 FLEAT-MGS and TL-2 SKT-MGS terminals described above and detailed in the enclosed drawings are acceptable for use on the NHS under the range of conditions tested, when acceptable to a highway agency.

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

- This acceptance is limited to the crashworthiness characteristics of the devices and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the device 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 device being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke our acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance, and that it will meet the crashworthiness requirements of the FHWA and the NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance is designated as number CC-88D and shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed at our office upon request.
- The FLEAT and SKT end terminals are patented products and considered proprietary. If proprietary devices are specified by a highway agency for use on Federal-aid projects, except exempt, non-NHS projects, (a) they must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with the existing highway facilities or that no equally suitable alternative exists; or (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.
- This acceptance letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented device for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate device, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely yours,

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

Enclosures

FHWA:HSSD:NArtimovich:tb:x61331:1/18/10

File: s://directoryfolder/nartimovich/CC88D\_RoadSystemsMGS.doc

cc: HSSD (Reader, HSA; Chron File, HSSD; N.Artimovich, HSSD; DNicol, HSSD)



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Vice President Technical Support and Marketing  
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## **Analysis**

NCHRP Report 350 guidelines recommend a total of up to seven full-scale crash tests for gating guardrail terminals. It was your opinion that no additional full-scale crash tests are required to evaluate the safety performance of these proposed TL-2 MGS terminal designs. First, the layouts of the TL-2 MGS terminals are the same as those for the FHWA-accepted TL-2 metric height terminals. This tells us that the proposed TL-2 MGS terminals will also be able to manage the energy of the impacting vehicle as did the crash-tested systems. Second, the TL-2 MGS terminal designs are essentially the same as those of the approved TL-3 MGS terminal designs except for the shorter terminal length and fewer breakaway posts.

## **Findings**

The modified TL-2 FLEAT-MGS and TL-2 SKT-MGS terminals described above and detailed in the enclosed drawings are acceptable for use on the NHS under the range of conditions tested, when acceptable to a highway agency.

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

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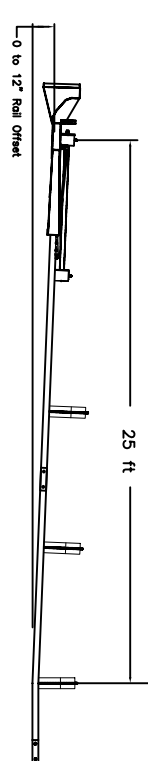
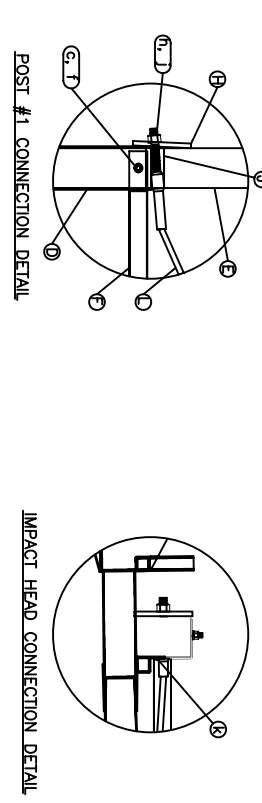
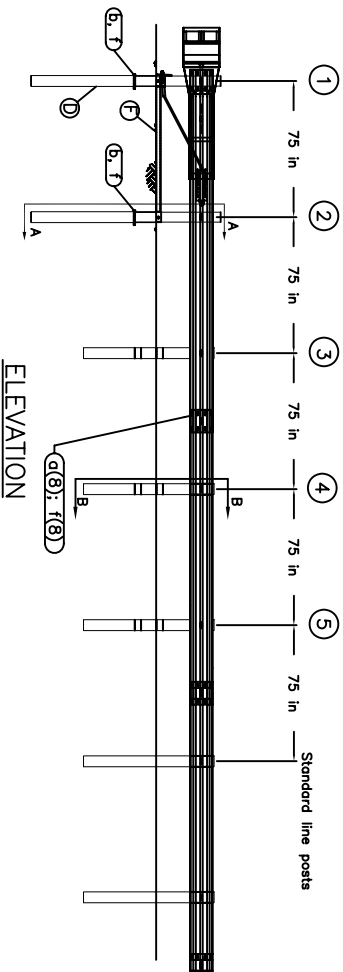
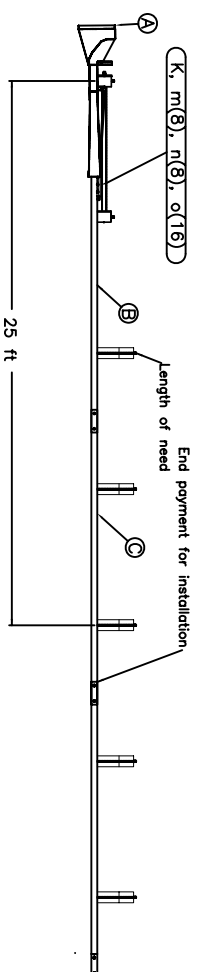
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the device being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke our acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance, and that it will meet the crashworthiness requirements of the FHWA and the NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance is designated as number CC-88D and shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed at our office upon request.
- The FLEAT and SKT end terminals are patented products and considered proprietary. If proprietary devices are specified by a highway agency for use on Federal-aid projects, except exempt, non-NHS projects, (a) they must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with the existing highway facilities or that no equally suitable alternative exists; or (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.
- This acceptance letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented device for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate device, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely yours,

A handwritten signature in dark ink, appearing to read "David A. Nicol", written in a cursive style.

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

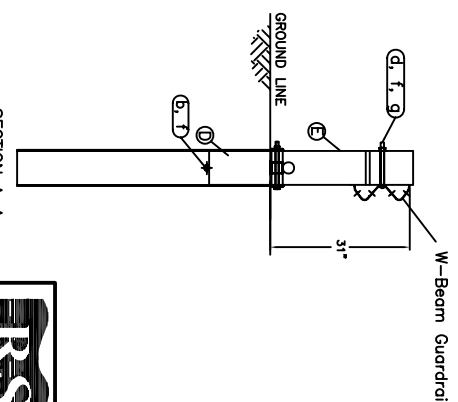
Enclosures



OPTIONAL FLARED INSTALLATION  
25:1 maximum flare rate

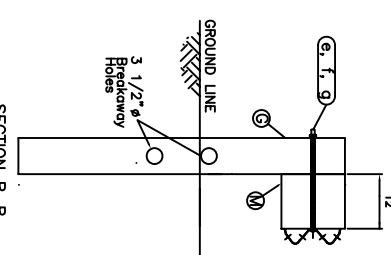
GENERAL NOTES:

1. Breakaway posts are required with the SKT.
2. All bolts, nuts, cable assemblies, cable anchors and bearing plates shall be galvanized.
3. The SKT can be flared at a rate of up to 25:1 to prevent the impact head from encroaching on the shoulder.
4. The foundation tubes shall not protrude more than 4" above the ground (measured along a 5' cord). Site grading may be necessary to meet this requirement.
5. When rock is encountered, a 12" Ø post hole, 20" into the rock surface may be used if approved by the engineer. Granular material will be placed in the bottom of the hole, approximately 2.5" deep to provide drainage. The first two posts can be field cut to length, placed in the hole and backfilled with adequately compacted material excavated from the hole.
6. The breakaway cable assembly must be taut. A locking device (vice grips or channel lock pliers) should be used to prevent the cable from twisting when tightening nuts.
7. A site evaluation should be considered if there is less than 25' between the outlet side of the terminal and any adjacent driving lane.
8. The soil tubes may be driven with an approved driving head. They shall not be driven with the post in the tube.
9. The wood blockouts should be "toe-nailed" to the rectangular wood posts to prevent them from turning when the wood shrinks.



SECTION A-A  
Post #2

ITEM NO.	ITEM QTY	BILL OF MATERIALS	ITEM NO.
A	1	IMPACT HEAD	SS300
B	1	W-BEAM GUARDRAIL END SECTION, 12 Ga.	MCS-SRT303
C	1	W-BEAM GUARDRAIL, 12 Ga.	MCS-G1203
D	2	FOUNDATION TUBE	E731
E	2	BCT WOOD POST	MCS-P650
F	1	GROUND STRUT	E780
G	3	CRT WOOD POST	MCS-P671
H	1	BEARING PLATE	E750
J	1	PIPE SLEEVE	E740
K	1	CABLE ANCHOR BOX	E760
L	1	BCT CABLE ANCHOR ASSEMBLY	E770
M	3	MCS TIMBER BLOCKOUT OR EQUIV.	P618
HARDWARE (ALL DIMENSIONS IN INCHES)			
a	16	5/8" x 1 1/4" SPICE BOLT	BS80122
b	2	5/8" x 7 1/2" HEX BOLT	BS80754
c	2	5/8" x 10 HEX BOLT	BS81004
d	1	5/8" x 10 H.G.R. BOLT	BS81002
e	3	5/8" x 22 H.G.R. BOLT	BS82202
f	24	5/8" H.G.R. NUT	N050
g	4	H.G.R. WASHER	W050
h	2	1 ANCHOR CABLE HEX NUT	N100
i	2	1 ANCHOR CABLE WASHER	W100
j	2	3/8" x 3 LAG SCREW	E350
k	2	CABLE ANCHOR BOX SHOULDER BOLT	SS99A
m	8	1/2" A325 STRUCTURAL NUT	N055A
n	8	1/2" A325 STR. WASHER	W055A
o	16	1 1/16" OD x 9/16" ID A325 STR. WASHER	W050A



SECTION B-B  
Posts 3 thru 5

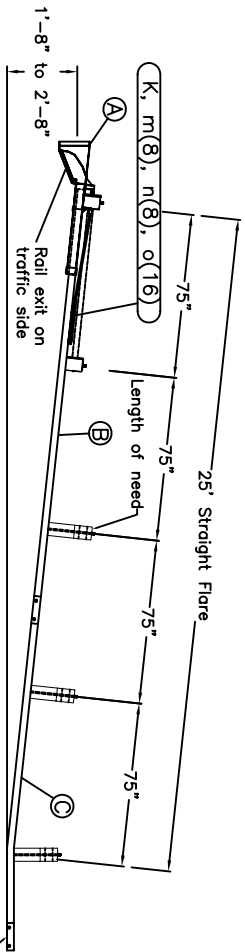
**Road Systems, Inc.**  
 1100 S. 1st St.  
 Phoenix, AZ 85004-3455  
 or Phone: 602-944-0744

**Sequential Kinking Terminal**  
 SKT - Assembly  
 Test Level - 2  
 Midwest Guardrail System  
 Wood Post System

Drawing Name: SKT-MGS-TL2-W-US  
 Scale: NONE  
 Rev: 0

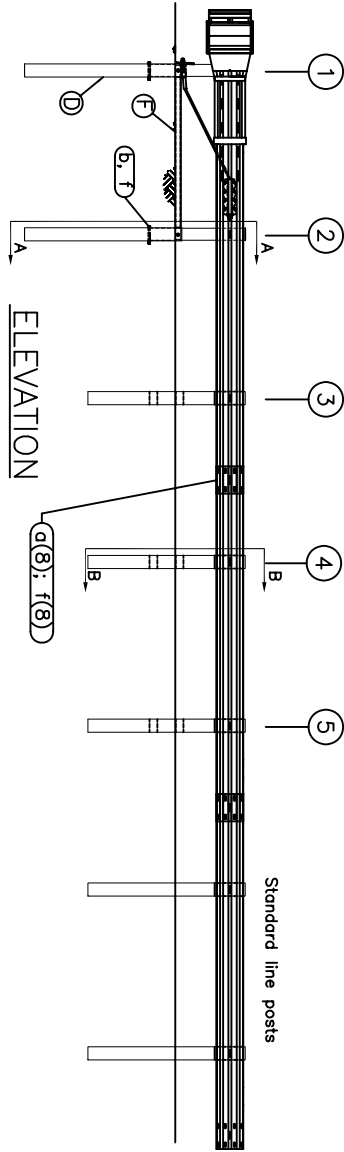
DATE: 06/28/09  
 BY: JRR

SCALE: NONE  
 REV: 0

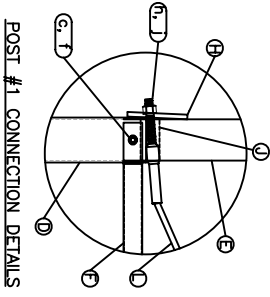


TRAFFIC  
PLAN

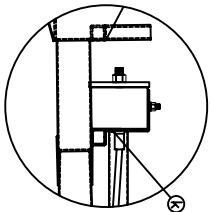
End payment for installation



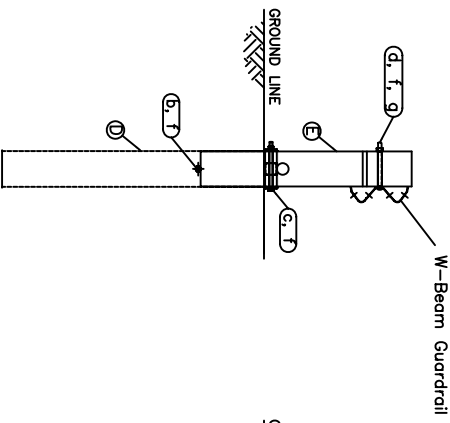
ELEVATION



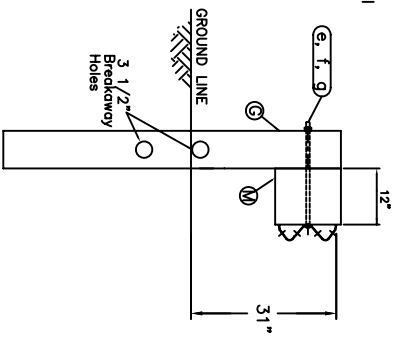
POST #1 CONNECTION DETAILS



IMPACT HEAD CONNECTION DETAIL



SECTION A-A  
Post #2



SECTION B-B  
Posts 3 thru 5

ITEM NO.	ITEM QTY	BILL OF MATERIALS
A	1	IMPACT HEAD
B	1	W-BEAM GUARDRAIL END SECTION, 12 Ga.
C	1	W-BEAM GUARDRAIL, 12 Ga.
D	2	FOUNDATION TUBE
E	2	BOY WOOD POST
F	1	GROUND STRUT
G	3	CRT WOOD POST
H	1	BEARING PLATE
J	1	PIPE SLEEVE
K	1	CABLE ANCHOR BOX
L	1	BOY CABLE ANCHOR ASSEMBLY
M	3	MCS TIMBER BLOCKOUT OR RECT. EQUIV.
HARDWARE (ALL DIMENSIONS IN INCHES)		
a	16	5/8" x 1 1/4" SPLICE BOLT
b	2	5/8" x 7 1/2" HEX BOLT
c	2	5/8" x 10 HEX BOLT
d	1	5/8" x 10 H.G.R. BOLT
e	3	5/8" x 22 H.G.R. BOLT
f	24	5/8" H.G.R. NUT
g	4	H.G.R. WASHER
h	2	1 ANCHOR CABLE HEX NUT
i	2	1 ANCHOR CABLE WASHER
j	2	3/8" x 3 LAG SCREW
k	2	CABLE ANCHOR BOX SHOULDER BOLT
m	8	1/2" A325 STRUCTURAL NUT
n	8	1/2" A325 STRUCTURAL NUT
o	16	1 1/16" OD x 9/16" ID A325 STR. WASHER

- GENERAL NOTES:
1. Breakaway posts are required with the FLEAT.
  2. All bolts, nuts, cable assemblies, cable anchors and bearing plates shall be galvanized.
  3. The foundation tubes shall not protrude more than 4 in above the ground (measured along a 5' cord). Site grading may be necessary to meet this requirement.
  4. When rock is encountered, a 12" Ø post hole, 20 in into the rock surface may be used if approved by the engineer. Granular material will be placed in the bottom of the hole, approximately 2.5' deep to provide drainage. The first two posts can be field cut to length, placed in the hole and backfilled with adequately compacted material excavated from the hole.
  5. The breakaway cable assembly must be taut. A locking device (vice grips or channel lock pliers) should be used to prevent the cable from twisting when tightening nuts.
  6. The soil tubes may be driven with an approved driving head. They shall not be driven with the post in the tube.
  7. The wood blockouts should be "toe-nailed" to the rectangular wood posts to prevent them from turning when the wood shrinks.

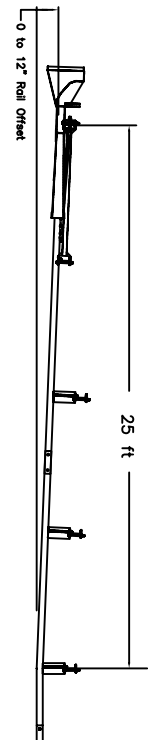
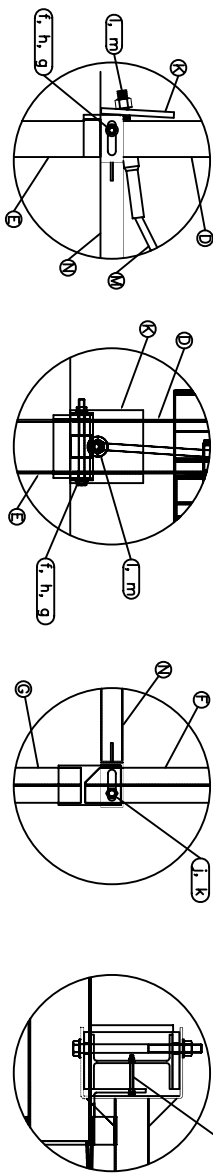
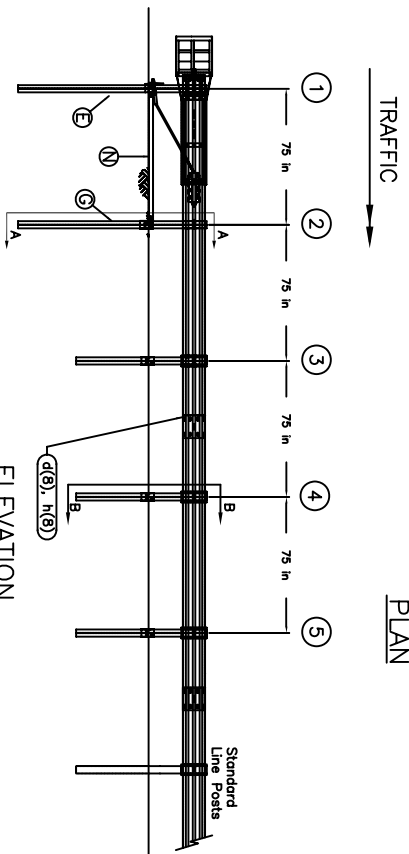
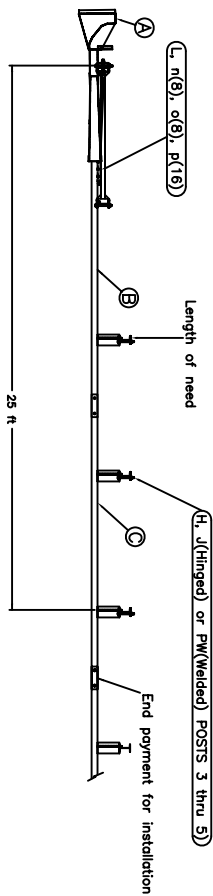
**Road Systems, Inc.**  
1100 S. 1st St.  
P.O. Box 1000  
St. Paul, MN 55101-1000

Flared Energy Absorbing  
Terminal - FLEAT Assembly  
Midwest Guardrail System  
Test Level - 2  
Wood Post System

Drawing Name: FL1-MGS-TL2-W-US  
Scale: None  
Rev: 0

Sheet: A1  
Date: 05/28/2009  
By: JRR

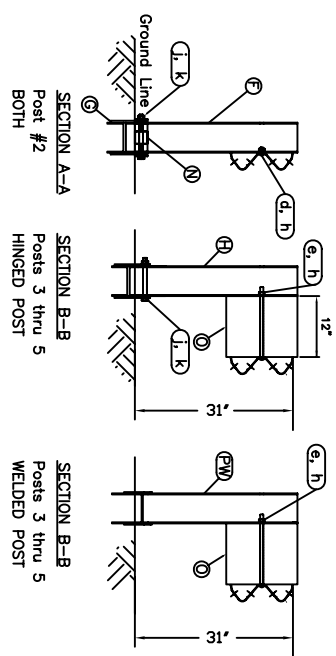




OPTIONAL FLARED INSTALLATION  
25:1 maximum flare rate

GENERAL NOTES:

1. Breakaway posts are required with the SKT.
2. All bolts, nuts, cable assemblies, cable anchors and bearing plates shall be galvanized.
3. The SKT can be flared at a rate of up to 25:1 to prevent the impact head from encroaching on the shoulder.
4. The lower sections of the posts shall not protrude more than 4" above the ground (measured along a 5' cord). Site grading may be necessary to meet this requirement.
5. The lower section of the hinged posts should not be driven with the upper post attached. If the post is placed in a drilled hole, the backfill material must be satisfactorily compacted to prevent settlement.
6. When rock is encountered, a 10" Ø post hole, 20" into the rock surface may be used if approved by the engineer. Granular material will be placed in the bottom of the hole, approximately 2.5' deep to provide drainage. Posts 1 & 2 can be field cut to length, placed in the hole and backfilled with adequately compacted material excavated from the hole.
7. The breakaway cable assembly must be fault. A locking device (vice grips or channel lock pliers) should be used to prevent the cable from twisting when tightening nuts.
8. A site evaluation should be considered if there is less than 25' between the outlet side of the terminal and any adjacent driving lane.



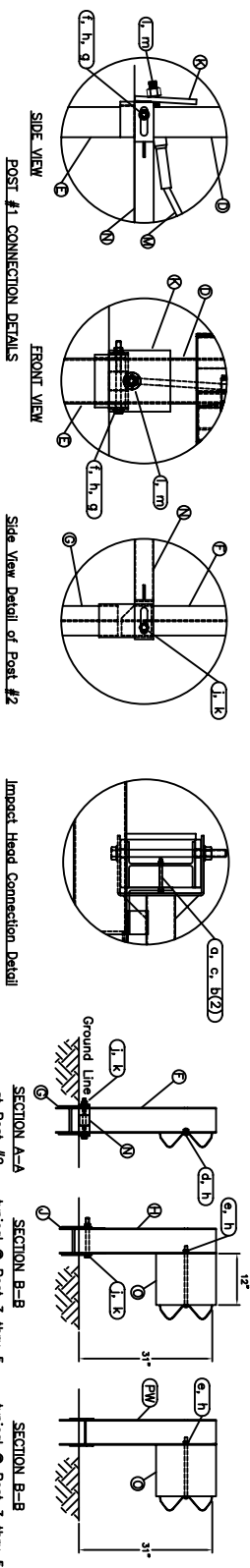
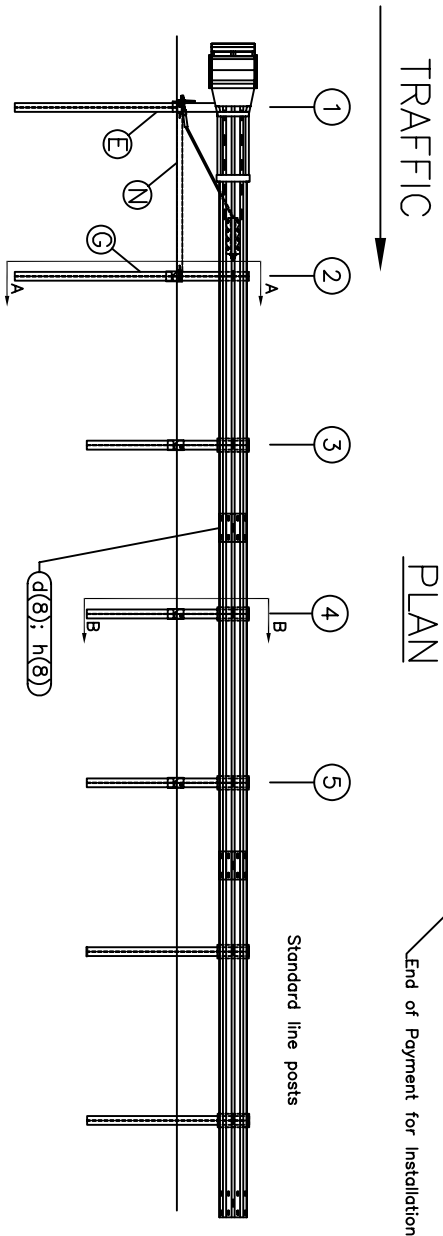
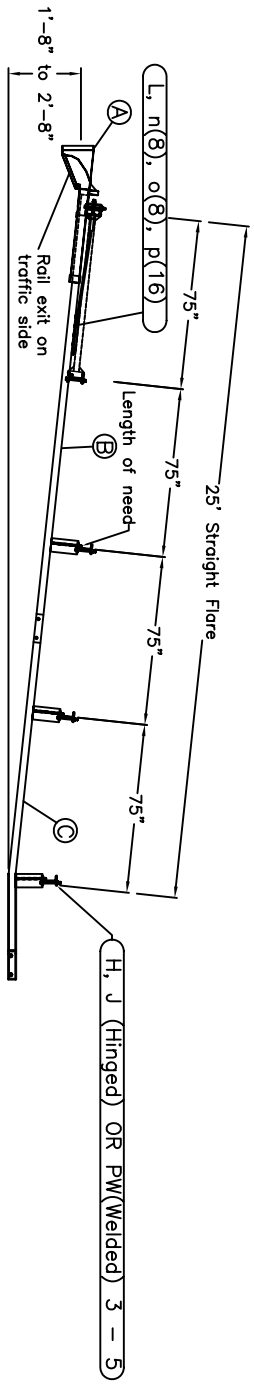
ITEM NO.	ITEM QTY	ITEM NO.
A 1	IMPACT HEAD	S3000
B 1	W-BEAM GUARDRAIL END SECTION, 12 Ga.	MGS-SF1303
C 1	W-BEAM GUARDRAIL, 12 Ga.	MGS-G1203
D 1	FIRST POST ASSEMBLY TOP	MGS-HP1A
E 1	FIRST POST ASSEMBLY BOTTOM	HP1B
F 1	SECOND POST ASSEMBLY TOP	MGS-HP2A
G 1	SECOND POST ASSEMBLY BOTTOM	HP2B
H 1	BREAKAWAY LINE POST TOP	MGS-HP3A
J 1	BREAKAWAY LINE POST BOTTOM	MGS-HP3B
K 1	BEARING PLATE	ET50
L 1	CABLE ANCHOR BOX	ST60
M 1	BOT CABLE ANCHOR ASSEMBLY	ET70
N 1	GROUND STRUT HINGED POST	ST85
O 1	MGS TIMBER BLOCKOUT OR RECC. EQUIV.	PG18
HARDWARE (ALL DIMENSIONS IN INCHES)		
a 2	1/4 x 4 HEX BOLT Grade 5	B140404A
b 4	1/4 WASHER	W014
c 2	1/4 HEX NUT	N014
d 17	5/8 Dia. x 1 1/4 SPLICE BOLT, POST #2	BS80122
e 3	5/8 Dia. x 14 H.G.R. BOLT (POSTS 3 THRU 5)	BS81402
f 1	5/8 Dia. x 9 HEX BOLT GRD 5	BS80904A
g 1	5/8 WASHER	W050
h 21	5/8 Dia. H.G.R. NUT	N050
j 1	4 3/4 Dia. x 8 1/2 HEX BOLT GRD A449	BS40854A
k 4	3/4 Dia. HEX NUT	N030
l 2	1 ANCHOR CABLE HEX NUT	N100
m 2	1 ANCHOR CABLE WASHER	W100
n 8	CABLE ANCHOR BOX SHOULDER BOLT	SB58A
o 8	1/2 A325 STRUCTURAL NUT	NS55A
p 16	1 1/16 OD x 9/16 ID A325 STR. WASHER	WS05A
WELDED POST QUANTITIES		
*PW 3	WELDED BREAKAWAY POST	PR621
*j 1	3/4 Dia. x 8 1/2 HEX BOLT GRD A449	BS40854A
*k 1	3/4 Dia. HEX NUT	N030

**Road Systems, Inc.**  
 1100 S. 10th St.  
 Phoenix, AZ 85006-3635  
 Phone: 602-944-3635  
 or Fax: 602-944-3635

**Sequential Kinking Terminal**  
 SKT Assembly  
 Test Level - 2  
 Midwest Guardrail System  
 Steel Post System  
 Hinged and Welded Options

Drawing Name: SKT-MGS-TL2-S-US  
 Scale: NONE  
 Rev: 0

Sheet: A1  
 Date: 06/28/09  
 By: JRR



SECTION A-A  
at Post #2  
BOTH

SECTION B-B  
typical Post 3 thru 5  
HINGED POSTS

SECTION B-B  
typical Post 3 thru 5  
WELDED POSTS

ITEM NO.	DESCRIPTION	QUANTITY
1	IMPACT HEAD	12000
2	W-BEAM GUARDRAIL, END SECTION, 12' O.C.	12000
3	W-BEAM GUARDRAIL, 12' O.C.	12000
4	W-BEAM GUARDRAIL, 12' O.C.	12000
5	W-BEAM GUARDRAIL, 12' O.C.	12000
6	W-BEAM GUARDRAIL, 12' O.C.	12000
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9	W-BEAM GUARDRAIL, 12' O.C.	12000
10	W-BEAM GUARDRAIL, 12' O.C.	12000
11	W-BEAM GUARDRAIL, 12' O.C.	12000
12	W-BEAM GUARDRAIL, 12' O.C.	12000
13	W-BEAM GUARDRAIL, 12' O.C.	12000
14	W-BEAM GUARDRAIL, 12' O.C.	12000
15	W-BEAM GUARDRAIL, 12' O.C.	12000
16	W-BEAM GUARDRAIL, 12' O.C.	12000
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99	W-BEAM GUARDRAIL, 12' O.C.	12000
100	W-BEAM GUARDRAIL, 12' O.C.	12000

**KSI**

**Road Systems, Inc.**

Big Spring, TX  
Phone: 409-265-2435  
or Phone: 281-344-0721

Drawing Name: FLT-MGS-TL2-S-US

Scale: None

Rev: 0

Sheet: A1

Date: 05/28/2009

By: JRR

Flared Energy Absorbing Terminal - FLAT Assembly

Midwest Guardrail System

Test Level - 2

Steel Post System

Hinged and Welded Options

GENERAL NOTES:

1. Breakaway posts are required with the FLAT.
2. All bolts, nuts, cable assemblies, cable anchors and bearing plates shall be galvanized.
3. The lower sections of the posts shall not protrude more than 4 in above the ground (measured along a 5' cord). Site grading may be necessary to meet this requirement.
4. The lower sections of the hinged posts should not be driven with the upper post attached. If the post is placed in a drilled hole, the backfill material must be satisfactorily compacted to prevent settlement.
5. When rock is encountered, a 10" Ø post hole, 20 in into the rock surface may be used if approved by the engineer. Granular material will be placed in the bottom of the hole, approximately 2.5' deep to provide drainage. The first two posts can be field cut to length, placed in the hole and backfilled with adequately compacted material excavated from the hole.
6. The breakaway cable assembly must be taut. A locking device (vice grips or channel lock pliers) should be used to prevent the cable from twisting when tightening nuts.