

This manual provides general information on proprietary crashworthy end terminal and barrier systems. The information on each system is from literature provided by the manufacturers and is not intended to reflect MoDOT policy or standards.

[Continue](#)

PROPRIETARY CRASHWORTHY END TERMINAL AND BARRIER SYSTEMS

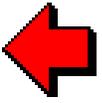
INTRODUCTION

Type A

Type B

Type C

Type D



INTRODUCTION

This manual provides general information on proprietary crashworthy end terminal and barrier systems. The information on each system is from literature provided by the manufacturers and is not intended to reflect MoDOT policy or standards.

Type A - D tables provide a summary of each system. Specifying two or less systems for a specific project location will require a public interest finding to be submitted to the Design Division for review, and if on an interstate route, approval by the FHWA.

This manual will be upgraded as additional information is received. Questions should be referred to the Design Standards Section.

[Intro Type A](#) - Type A Crashworthy End Terminal Systems Data

[Intro Type B](#) - Type B Crashworthy End Terminal Systems Data

[Intro Type C](#) - Type C Crashworthy Sand Barrells Data

[Intro Type D](#) - Type D Crashworthy Barrier Systems Data

TYPE A CRASHWORTHY END TERMINAL SYSTEMS

System	NCHRP 350 Test Level	Crash Cushion /End Terminal			Used as L-O-N (1)	System Width	System Length (2)	Engineer's Estimate for Installment	% Reusable or Average Repair Cost	Max. Cross-Slope	Clear Zone Req'd. (3)	Hazard Location			Reverse Impact Treated	Two-Way Traffic	Deck/ Structure Required	Comments
		R	G	NR								M	G	R				
ET-2000	TL-3	x	x		11.4 m (37' - 6")	0.5 m (1' - 9")	15.2 m (50' - 0")	\$2500	\$300-\$500	10:1	22.5 m x 6 m (75' x 20')	x		x	x			Do not use if the distance to the opposing lane of traffic is less than or equal to 25'.
LET	TL-3	x	x		7.6 m (25' - 0")	0.5 m (1' - 9")	11.4 m (37' - 6")	\$2100	\$300-\$500	10:1	22.5 m x 6 m (75' x 20')	x		x	x			Do not use if the distance to the opposing lane of traffic is less than or equal to 25'.
BEST	TL-3	x	x		7.6 m (25' - 0") or 11.4 m (37' - 6")	0.5 m (1' - 9")	11.4 m (37' - 6") or 15.2 m (50' - 0")	\$2100	\$300-\$500	10:1	22.5 m x 6 m (75' - 20')	x		x	x			Do not use if the distance to the opposing lane of traffic is less than or equal to 25'.
SKT	TL-3	x	x		11.4 m (37' - 6"0	0.5 m (1' - 9")	15.2 m (50' - 0')	\$2100	\$300-\$500	10:1	22.5 m x 6 m (75' x 20')	x		x	x			Do not use if the distance to the opposing lane of traffic is less than or equal to 25'.
SRT-350	TL-3	x	x		7.6 m (25' - 0")	0.5 m (1' - 9") plus 1.2 m (4') Flare	11.4 m (37' - 6")	\$1950	\$600-\$1100	10:1	22.5 m x 6 m (75' x 20')			x	x			Do not use in median or behind curb sections.
ISRT-3	TL-3	x	x		7.6 m (25' - 0")	0.5 m (1' - 9") plus 0.91 m (3') Flare	11.4 m (37' - 6")	\$1950	\$600-\$1100	10:1	22.5 m x 6 m (75' x 20')			x	x			Do not use in median or behind curb sections.
FLEAT	TL-3	x	x		7.6 m (25' - 0")	0.5 m (1' - 9") plus 1.2 m (4') Flare	11.4 m (37' - 6")	\$1950	\$600-\$1100	10:1	22.5 m x 6 m (75' x 20')			x	x			Do not use in median or behind curb sections.
REGENT	TL-3	x	x		7.6 m (25' - 0")		11.4 m (37' - 6")	\$1950	\$600-\$1100	10:1	22.5 m x 6 m (75' x 20')			x	x			Do not use in median or behind curb sections.
ROSS-350	TL-3	x	x		7.6 m (25' - 0")	0.5 m (1' - 9") plus 0.9 m (3') Flare	11.4 m (37' - 6")	\$1950	\$600-\$1100	10:1	22.5 m x 6 m (75' x 20')			x	x			Do not use in median or behind curb sections.

(1) Use designated length of system as part of required length of need to protect a hazard.

(2) System length does not include transition section required to connect system to guardrail, median barrier or retaining wall.

(3) Based on 62.5 mph.

(4) Depends on site geometric conditions and design speed.

Crash Cushion/End Terminal

R = Redirectional

G = Gating

NR = Non-Redirectional

Hazard Location

M = Median

G = Gore

R = Roadside

INTRO TYPE A

TYPE B CRASHWORTHY END TERMINAL SYSTEMS

System	NCHRP 350 Test Level	Crash Cushion /End Terminal			Used as L-O-N (1)	System Width	System Length (2)	Engineer's Estimate for Installment	% Reusable or Average Repair Cost	Max. Cross-Slope	Clear Zone Req'd. (3)	Hazard Location			Reverse Impact Treated	Two-Way Traffic	Deck/ Structure Required	Comments		
		R	G	NR								M	G	R						
C-A-T 350	TL-3	x	x		5.6 m (18' - 6")	0.7 m (2' - 5")	9.5 m (31' - 3")	\$5000-\$6000 (w/TRANSITION \$6000-\$7000)	\$1200-\$2500	10:1	22.5 m x 6 m (75' x 20')	x	x	x	x	x		System length = 13.1 m (43') with basic transition. System length - 19.2 m (63') when attached to rigid barrier or object. Do not use in medians or gore areas less than 3 m (10') wide.		
BRAKEMASTER	TL-3	x	x		None	0.64 m (25")	9.6 m (31' - 6")	\$5000-\$6000 (w/TRANSITION \$6000-\$7000)	20%	12:1 / 8%	22.5 m x 6 m (75' x 20')	x	x	x	x	x		Do not use in medians or gore areas less than 3 m (10') wide. Transition section required when attached to a rigid barrier. The first 1.9 m (6'-3") guardrail section connected to the system shall not angle more than 3 degrees laterally from the system's centerline.		
QUADGUARD Model 2 Bays	TL-1	x			None	.61 - 2.29 m (2' - 7.5')	2.66 m (8' - 9")	\$5000	\$1200-\$2500	1.5:1	None	x	x	x	x	x	x		Requires concrete pad.	
4 Bays	TL-2			4.49 m (14' - 9")																\$7000
9 Bays	TL-3			9.06 m (29' - 9")																\$10,000
QUADGUARD CZ Model 3 Bays	TL-2	x			None	.61 - .76 m (2' - 2.5')	3.58 m (11' - 9")		\$1200-\$2500	8%	None	x	x	x	x	x	x		Use for temporarily locations primarily, but may be installed to function as a permanent protection. Requires either asphalt or concrete pads.	
6 Bays	TL-3			6.33 m (20' - 9")																
QUADTREND - 350	TL-3	x	x		None					10:1				x			x	Used as a transition element end terminal for right longitudinal barriers.		
ADIEM II (30.00')	TL-3	x	x		4.3 m (14' - 0")	0.7 m (2' - 4")	9.1 m (30' - 0")	\$14,000	40% / \$2500-\$5000	10:1	22.5 m x 6 m (75' x 20')	x	x	x	x	x	x	Not recommended on loose soil and must be installed to function as a permanent protection. Requires either asphalt or concrete pads.		
REACT 350 Model 350-4 (45 mph)	TL-1	x			None	0.9 m (3' - 0")	4.8 m (15' - 8")	\$16,000	100%	6%	None	x	x	x	x	x	x		Use for high frequency impact locations.	
350-6 (55 mph)	TL-2			6.6 m (21' - 8")																\$19,000
350-9 (70 mph)	TL-3			9.3 m (30' - 8")																\$24,000
WIDE REACT	TL-3	x	x		None				100%	6%	None	x	x	x	x	x	x	Use for high frequency impact locations.		

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(3) Based on 62.5 mph.

(4) Depends on site geometric conditions and design speed.

Crash Cushion/End Terminal

R = Redirectional

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NR = Non-Redirectional

Hazard Location

M = Median

G = Gore

R = Roadside

INTRO TYPE B

TYPE C CRASHWORTHY SAND BARRELS

System	NCHRP 350 Test Level	Crash Cushion /End Terminal			Used as L-O-N (1)	System Width	System Length (2)	Engineer's Estimate for Installment	% Reusable or Average Repair Cost	Max. Cross- Slope	Clear Zone Reqd. (3)	Hazard Location			Reverse Impact Treated	Two- Way Traffic	Deck/ Structure Required	Comments
		R	G	NR								M	G	R				
ENERGITE SYSTEM (Sand Barrels)	TL-3			x	N/A	1.7 m (5' - 6')	Variable	\$250 / Barrel	0%	5%	None	x	x	x	x	x	x	Requires flat pad, preferably paved.
FITCH UNIVERSAL MODULE (Sand Barrels)	TL-3			x	N/A	1.7 m (5' - 6')	Variable	\$250 / Barrel	0%	5%	None	x	x	x	x	x	x	Requires flat pad, preferably paved.
TrafFix (SAND BARRELS)	TL-3			x	N/A	1.7 m (5' - 6')	Variable	\$250 / Barrel	0%	5%	None	x	x	x	x	x	x	Requires flat pad, preferably paved.

(1) Use designated length of system as part of required length of need to protect a hazard.

(2) System length does not include transition section required to connect system to guardrail, median barrier or retaining wall.

(3) Based on 62.5 mph.

(4) Depends on site geometric conditions and design speed.

Crash Cushion/End Terminal

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G = Gating

NR = Non-Redirectional

Hazard Location

M = Median

G = Gore

R = Roadside

INTRO TYPE C

TYPE D CRASHWORTHY BARRIER SYSTEMS

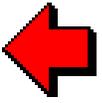
System	NCHRP 350 Test Level	Crash Cushion /End Terminal			Used as L-O-N (1)	System Width	System Length (2)	Engineer's Estimate for Installment	% Reusable or Average Repair Cost	Max. Cross-Slope	Run-Out Req'd. (3)	Hazard Location			Reverse Impact Treated	Two-Way Traffic	Deck/ Structure Required	Comments
		R	G	NR								M	G	R				
NEAT	TL-2		x	x	None		3 m (3' - 10")	\$2500-\$3000	10%		N/A	x		x				Can be connected directly to concrete barrier.
TRITON BARRIER	TL-2	x	x		All	0.5 m (2' - 9")	2 m (78") (0.8 m / 32" ht.)	\$4500 / 10 sections	60%	5%	Varies (4) Max deflection = 5.2 m (17')	x		x	x	x		Minimum length required = 30 m (100') (15 sections). Requires 550 liters (145 gal) per section. Effective in sub-freezing conditions.
GUARDIAN SAFETY BARRIER	TL-3	x	x		All	0.61 m (2' - 0")	1.83 m (6' - 0")	\$575 / section	95%		Max deflection = 3.4 m (11.15')	x		x	x	x		Minimum length required = 60.5 m (198.5'). Requires 693 liters (183 gal) per section. Effective in sub-freezing conditions.
CUSHION WALL	N/A	x			N/A	Custom	Custom	Variable	100%	N/A	N/A			x	x	x		Protection for retaining walls.
BARRIERGATE	TL-3	x			All	.305 m (1.0')	0.991 m / section (3.25')	Variable	50%	4%	N/A	x			x	x		Provides a gate in median barrier for emergency vehicle use.

- (1) Use designated length of system as part of required length of need to protect a hazard.
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 (4) Depends on site geometric conditions and design speed.

Crash Cushion/End Terminal
 R = Redirectional
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 NR = Non-Redirectional

Hazard Location
 M = Median
 G = Gore
 R = Roadside

INTRO TYPE D



INTRODUCTION

Type A

ET-2000

LET

BEST

SKT

SRT-350

ISRT-3

FLEAT

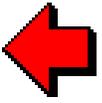
REGENT

ROSS-350

Type B

Type C

Type D



INTRODUCTION

Type A

Type B

C-A-T 350

BRAKEMASTER

QUADGUARD

QUADGUARD CZ

QUADTREND-350

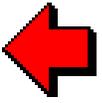
ADIEM II

REACT 350

WIDE REACT

Type C

Type D



INTRODUCTION

Type A

Type B

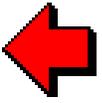
Type C

ENERGITE SYSTEM

FITCH UNIVERSAL MODULE

TRAFFIX

Type D



INTRODUCTION

Type A

Type B

Type C

Type D

NEAT

TRITON BARRIER

GUARDIAN SAFETY BARRIER

CUSHION WALL

BARRIERGATE



ET-2000

A1

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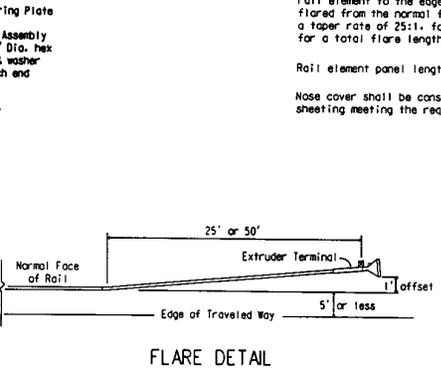
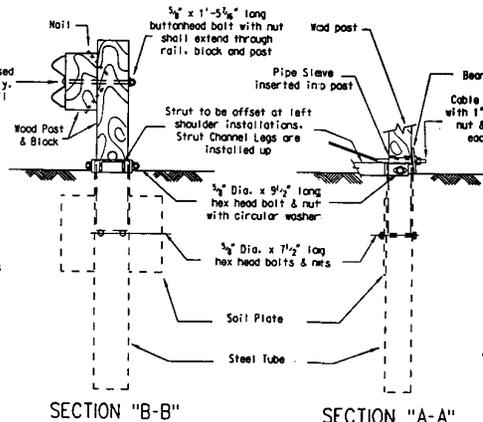
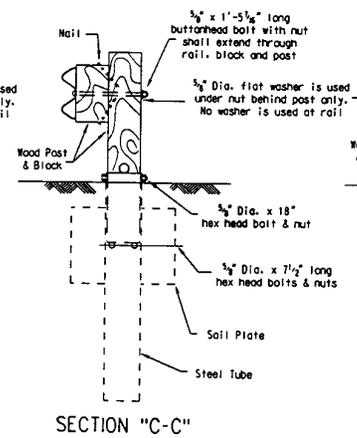
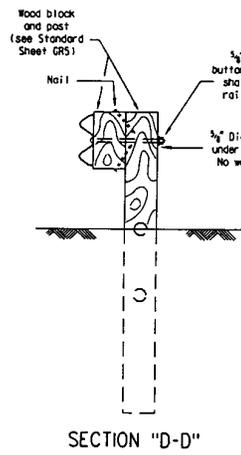
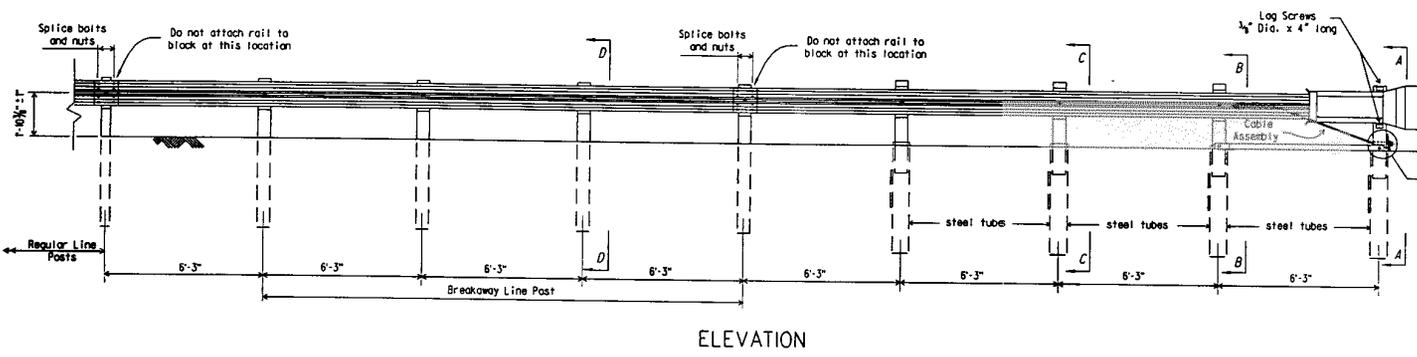
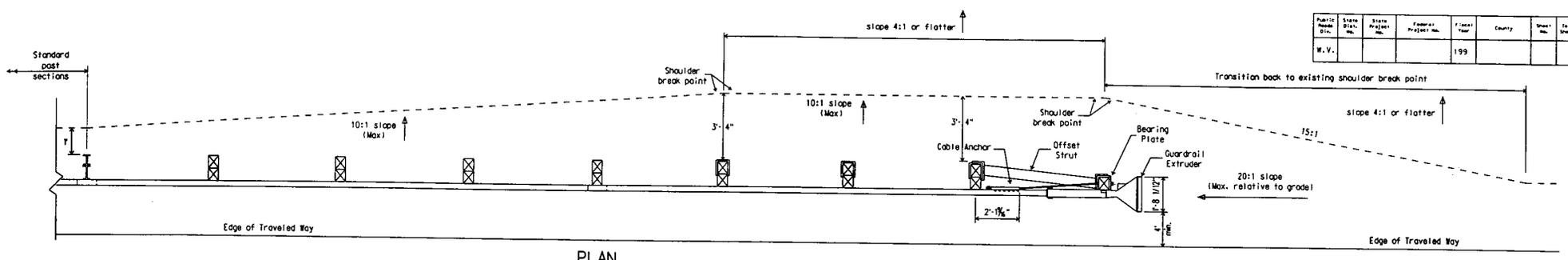
Internet Information

ET-2000 Plan Sheet

For general and the latest information on ET-2000, please refer to www.trin.net.

The following is in addition to the information provided at the above website.

Public Road Dist.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W.V.				199			



WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
SPECIAL DETAIL

PREPARED 10-31-96
REVISION DATE

**SPECIAL APPROACH END TERMINAL
OPTION "B"**
(SHEET 2 OF 2)

NOTES:

For details of Anchor Plate, Anchor Plate Assembly, Cable Assembly Steel Tube, Soil Plate, Post Sleeve, Bearing Plate, and other miscellaneous hardware, see Standard Sheet GR6.

All materials used shall meet the applicable requirements of Section 607 of the Standard Specifications Roads and Bridges.

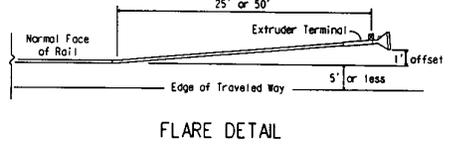
The wood block shall be nailed to the post with a galvanized steel 10d common nail. The nails are to be driven into the center of the top or bottom of the block.

The cost of furnishing and installing the Special Approach End Terminal, complete with all miscellaneous hardware and parts as detailed on this Special Detail, is to be included in the unit price bid for Special Approach End Terminal. Normal guardrail components: i.e. posts, blocks, rail elements, hardware, etc.; along with the special size and/or special length wood guardrail posts, shall be paid for as guardrail per foot.

The Special Approach End Terminal installation shall maintain a 4' minimum offset from the edge of the extruder terminal to the edge of the traveled way. For narrow existing shoulders that have an offset of 5' or less from the face of the rail element to the edge of the traveled way, the rail and terminal may be flared from the normal face of rail. The flared offset distance shall be 1' at a taper rate of 25:1, for a total flare length of 25'; or a taper rate of 50:1, for a total flare length of 50' (see Flare Detail).

Rail element panel lengths shall be 25' only. Shorter lengths shall not be used.

Nose cover shall be constructed of aluminum and covered with yellow retroreflective sheeting meeting the requirements of ASTM D4956-90 Type V with No. 42 adhesive.





LET

A2

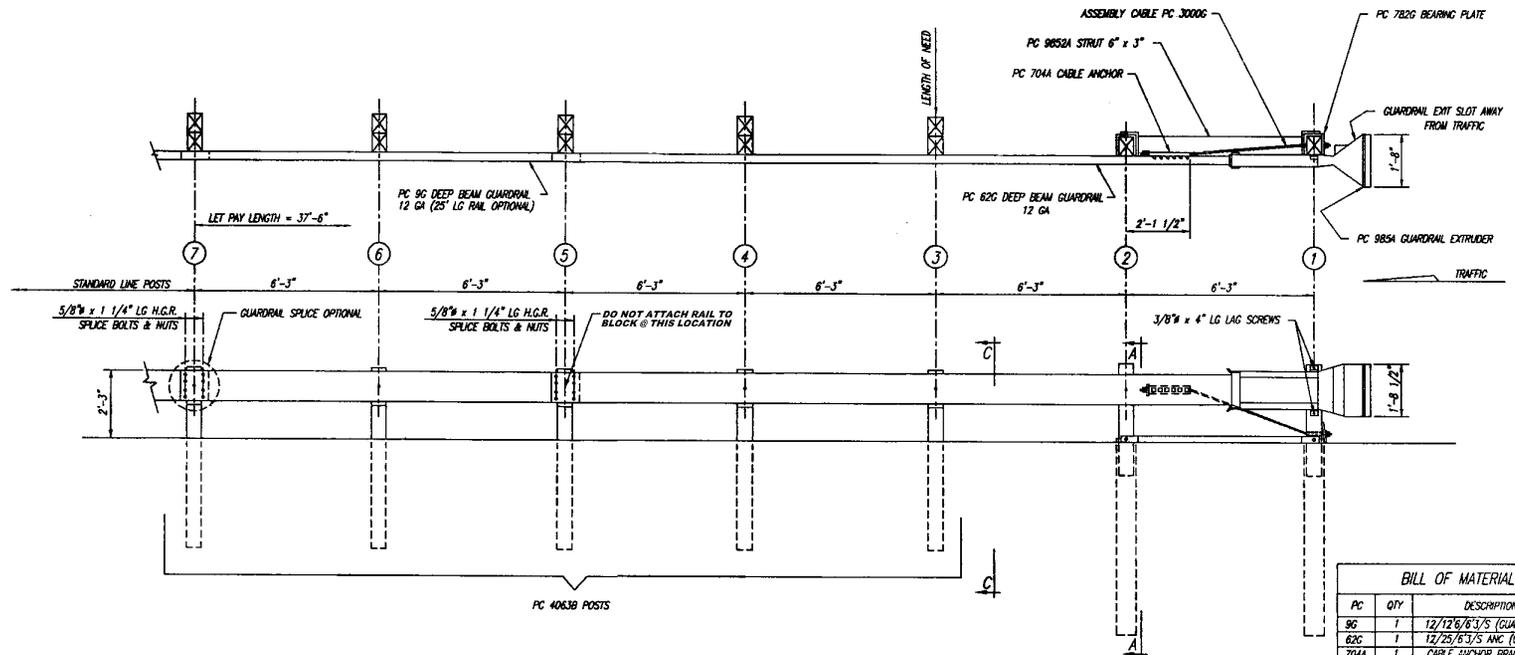
Contains:

Differences Between LET & ET-2000

LET Plan Sheet

The LET is a modified ET-2000. The LET is identical to the ET-2000, except as follows:

1. Use of 190-mm (6' 6") soil tubes without soil plates for posts 1 and 2.
2. Use of standard CRT posts for posts 3 through 7. This results in replacing the shortend, tube-supported post 3 and 4 with full length CRT posts and in replacing the original CRT post 8 with a standard line post.
3. Elimination of the offset block at post 2, permitting the use of an in-line strut at ground level.
4. The LET is 37.5' long, 12.5' shorter than the ET-2000. Therefore, an additional 12.5' section of Type A guardrail must be installed with the LET to obtain the length of need equivalence to that of the ET-2000 (Option B) system.
5. Attached is a plan drawing of the LET. For general information, please refer to ET-2000 at <http://www.trin.net>.

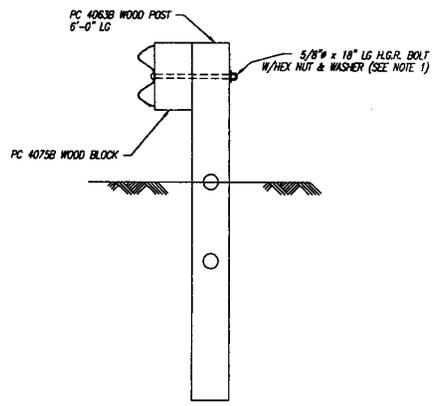


BILL OF MATERIAL

PC	QTY	DESCRIPTION
9G	1	12/12/6/6/3/S (GUARDRAIL)
62G	1	12/25/6/3/S ANC (GUARDRAIL)
704A	1	CABLE ANCHOR BRACKET
705G	1	2" x 5 1/2" PIPE
732G	2	6/8 TUBE SLEEVE
782G	1	5/8" x 8" x 8" BEARING PLATE
985A	1	ET-2000 EXTRUDER
3000G	1	CABLE 3/4 x 6/8
3300G	10	3/8" WASHER
3340G	28	5/8" HEX NUT
3360G	16	5/8" x 1 1/4" SPUCE BOLT
3478G	4	5/8" x 7 1/2" HEX HD BOLT
3497G	2	5/8" x 9 1/2" HEX HD BOLT
3500G	1	5/8" x 10" POST BOLT
3580G	5	5/8" x 18" POST BOLT
3800G	2	1" WASHER
3810G	2	1" HEX NUT
4063B	5	WD 6/0 POST 6 x 8
4075B	5	WD BLOCK 1/2 x 6 x 8 DR
4147B	2	WD 3/9 POST 5 1/2 x 7 1/2
4228C	2	3/8" x 4" LAG SCREW
9852A	1	STRUT & YOKE

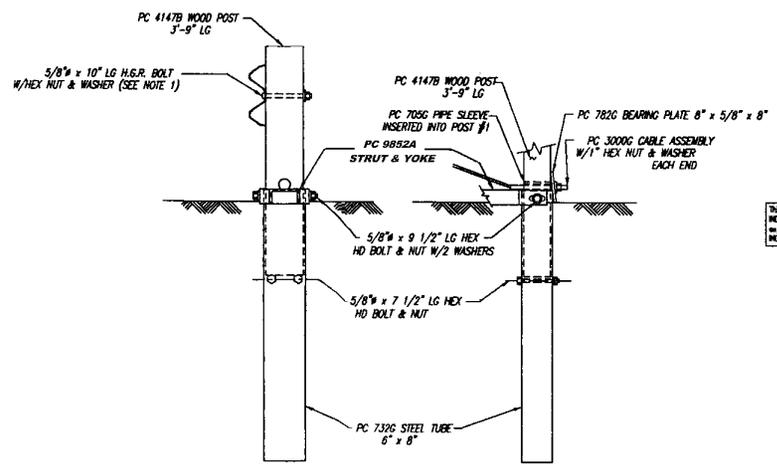
NOTES:
 1) THE 5/8" FLAT WASHER IS USED UNDER THE NUT, BEHIND THE POST ONLY. NO WASHER IS USED AT THE RAIL.
 2) MANUFACTURER SUGGESTS CUSTOMER TO PROVIDE REFLECTORIZATOR OF TERMINAL.

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NOTE:
SECTION "C-C" IS SIMILAR @ POST #5 EXCEPT RAIL IS NOT ATTACHED.

SECTION "C-C"
(TYP @ POSTS #3, 4, 5, 6 & 7)



SECTION "A-A"
(@ POST #2)

PARTIAL VIEW @ POST #1

REV	CHG'D	BY	DATE	REMARKS
1		BT	6-20-97	ADDED PC 3478, CHG QUANTITY PC 3340
ET2000-LET				
ET2000 - LET PLAN, ELEVATION & SECTIONS				
CUSTOMER	P.O. No.		DATE	12-20-96
			ENG. FILE #	SS280
TRINITY INDUSTRIES, INC. DALLAS, TX GRAND, OH FORT WORTH, TX CENTRALIA, UT LIMA, OH ELIZABETHTOWN, KY			SURO SHL. No. ET OF 1 DRAWING No. SS 260	DRAWN B.T. CHECKED APPROVED 1



BEST

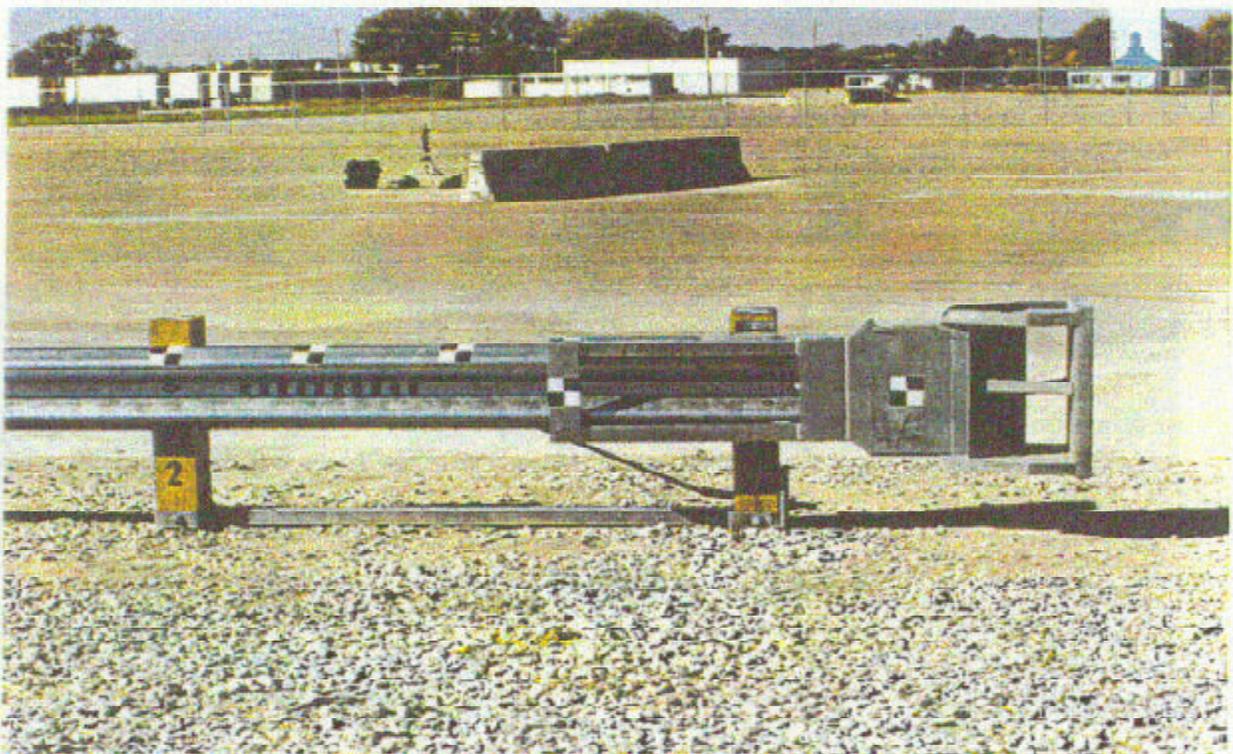
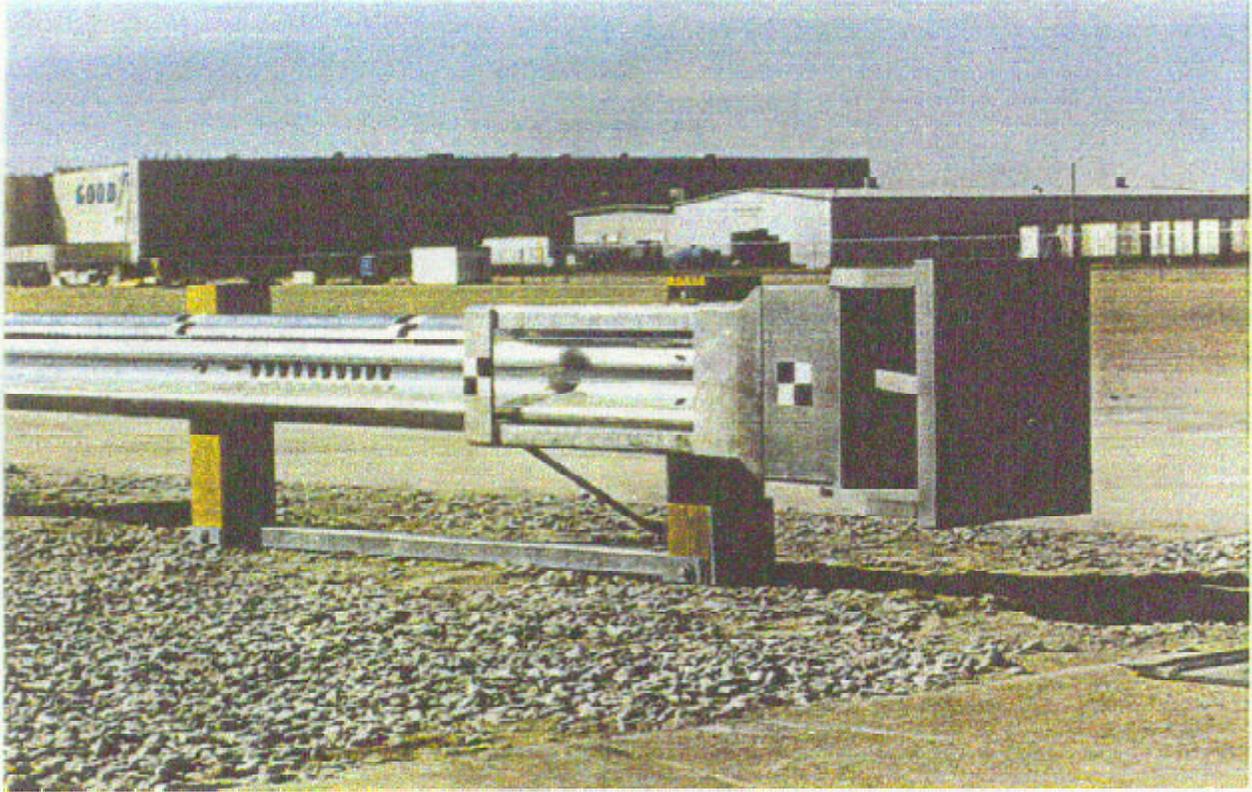
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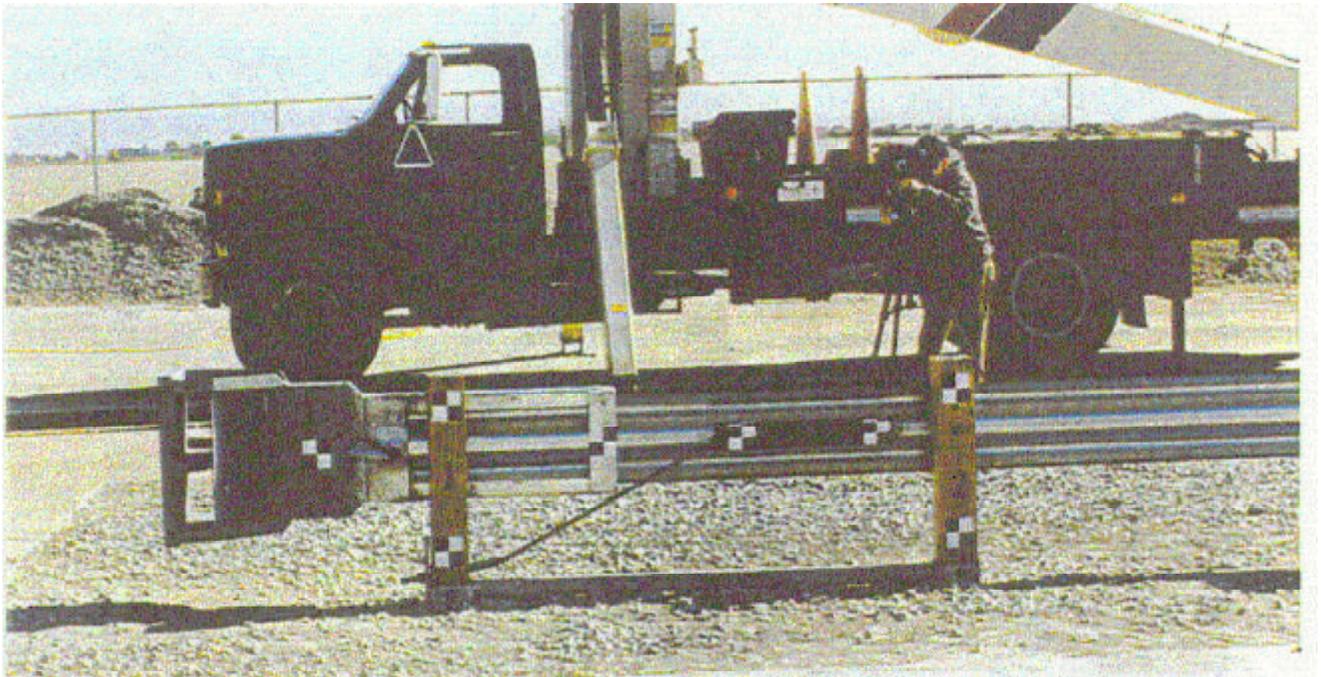
Photos of BEST System

Schematic of BEST System

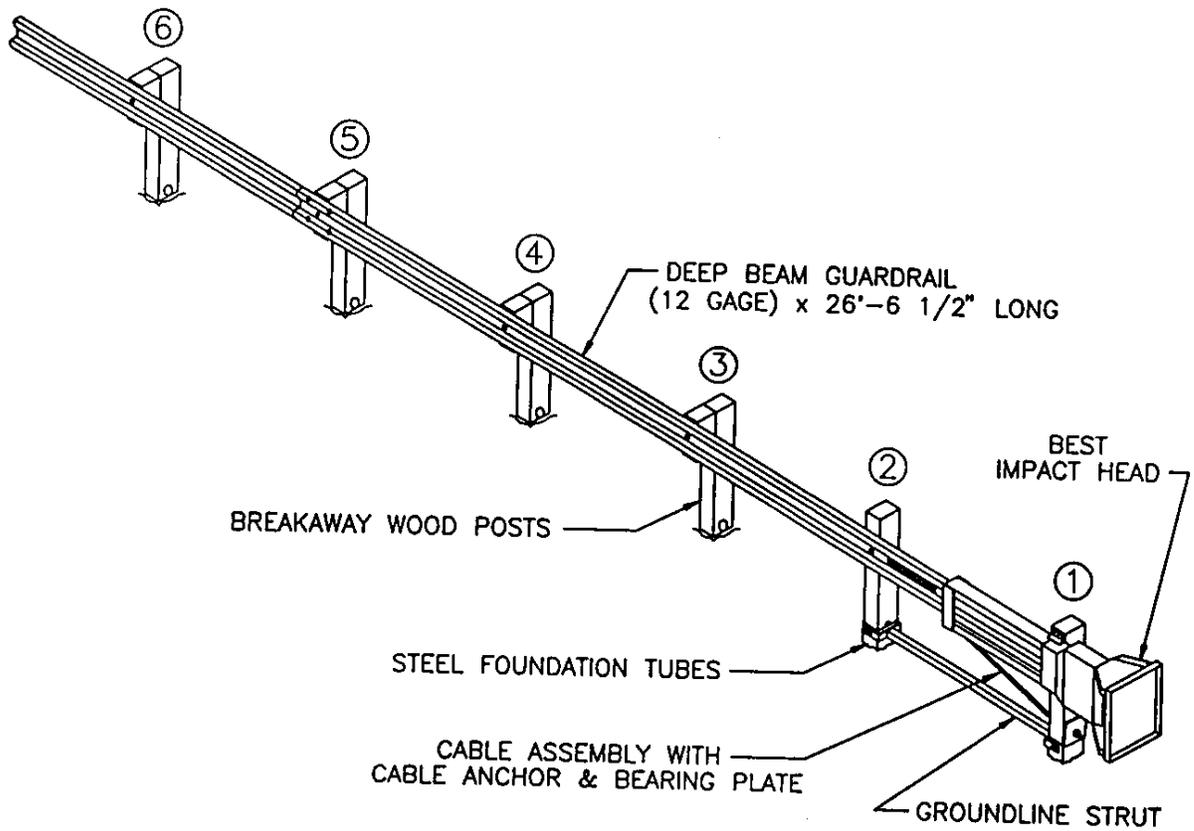
BEST System Plan Sheet



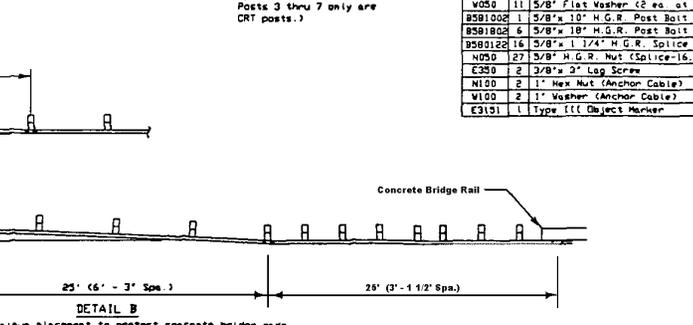
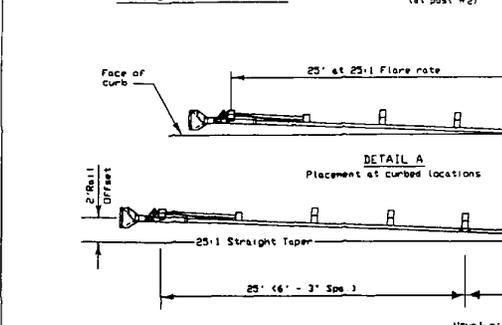
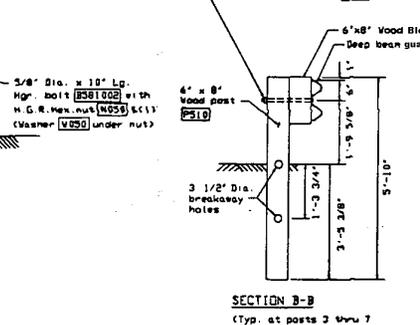
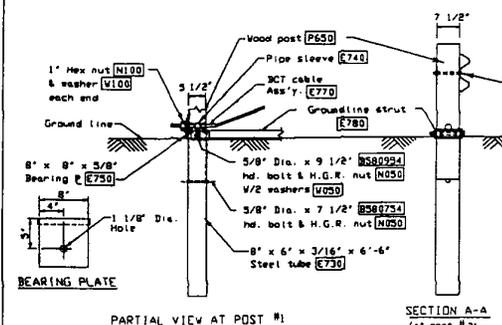
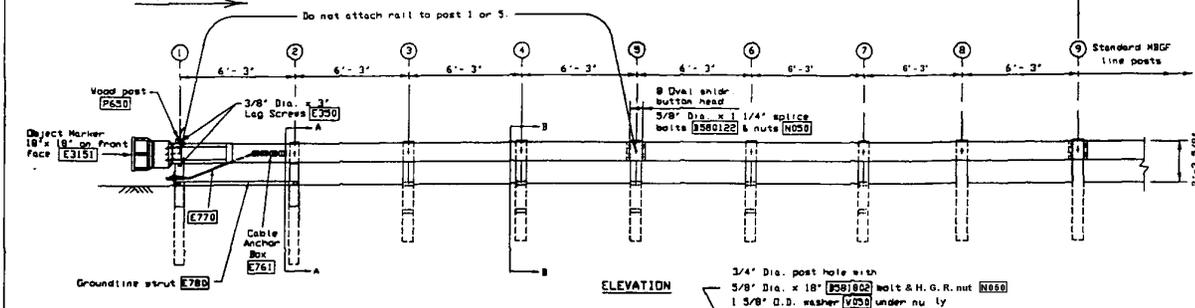
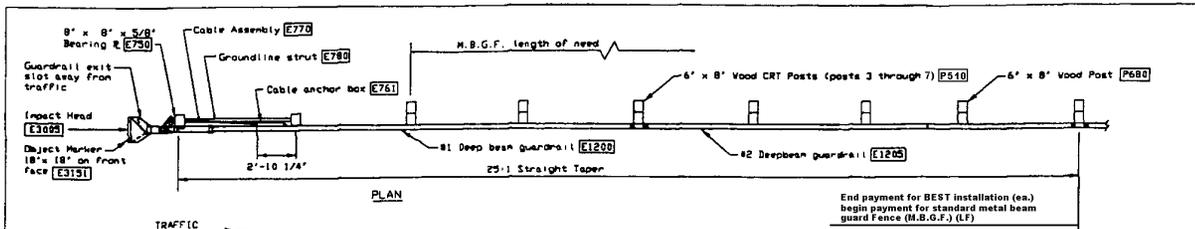
Photographs of the BEST system.



Photographs of Best system (continued).



Schematic of the BEST system

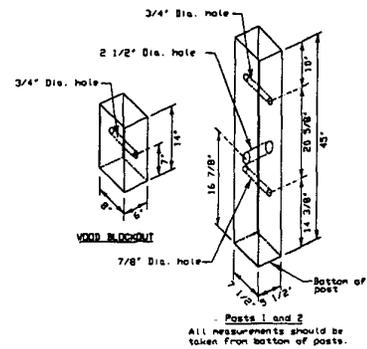


GENERAL NOTES

1. Wood posts are required with the Bean Eating Steel Terminal (BEST).
2. All bolts, nuts, cable assemblies, cable anchors and bearing plates shall be galvanized.
3. When the Bean Eating Steel Terminal is selected as the end treatment for MBSF installation, the MBSF will be flared at a rate of 25:1 over the first 30 feet of the system. The flare may be decreased or eliminated for specific installations if directed by the Engineer. A 25:1 Flare rate will be used at curb sections, beginning at post number five and ending at post number one.
4. The steel tubes shall not protrude more than 4 inches above ground (measured along a 5' foot cord). Site grading may be necessary to meet this requirement.
5. The steel tubes may be driven with an approved driving head. They shall not be driven with the wood post in the tube. If the steel tubes are placed in drilled holes, the backfill material must be satisfactorily compacted to prevent tube settlement.
6. When rock excavation is encountered, a 12 inch diameter post hole, 20 inches deep may be used if approved by the Engineer. Granular material will be placed in the bottom of the hole approximately 2 1/2 inches deep to provide drainage. The steel tube sleeves will be field cut to 20 inches in length, placed in the hole and backfilled with adequately compacted material excavated from the hole.
7. 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 the nuts.
8. The wood blockouts shall be "ice nailed" to the rectangular wood posts to prevent them from turning when the wood strikes.
9. For curb installations, the soil tubes end posts shall be installed at the proper ground elevation behind the curb. The posts will then require field drilling new holes to accommodate the rail to post connection bolts to maintain the proper height of the rail above the gutter pan. The excess post length above the rail will be removed if directed by the Engineer.
10. An object marker shall be installed on the front of the BEST Impact Head.
11. A special site evaluation should be considered, prior to using the BEST where there is less than 25 feet between the extrusion side of the BEST and any adjacent driving lane.

BEST Bill of Materials

Code	Qty	DESCRIPTION
E1200	1 #1	Deep Beam Guardrail (26'-6 1/2" x 12 Ga.)
E1205	1 #2	Deep Beam Guardrail (26'-1 1/2" x 12 Ga.)
E730	2	Steel Tube - 6' x 8' x 5'-5 1/4" x 3/16"
P650	2	Wood Posts - 3 1/2" x 7 1/2" x 45'
P510	5	6' x 8' x 5'-10" Wood CRT Posts
P680	1	6' x 8' x 4" Wood Post
P676	6	6' x 8' x 14" Wood Blockouts
E740	1	Pipe Sleeve - 2" Std. Pipe x 3 1/2"
E750	1	Bearing Plate - 8' x 8' x 5/8"
E761	1	Cable Anchor Box
E770	1	Cable Assembly
E780	1	Groundline Strut
E3025	1	BEST Impact Head
HARDWARE		
B590754	2	5/8" x 7 1/2" Hex Hd. Bolt (bottom of tubes)
B582954	2	5/8" x 9 1/2" Hex Hd. Bolt (top of tubes)
N050	11	5/8" Flat Washer (2 ea. on Tubes + 7 Posts)
B581002	1	5/8" x 10" H.G.R. Post Bolt (Post 2)
B581802	6	5/8" x 10" H.G.R. Post Bolt (Posts 3 through 8)
B580122	16	5/8" x 1 1/4" H.G.R. Splice Bolt
N050	27	5/8" H.G.R. Nut (Splice=16, Tubes=4, CR-7)
E350	2	3/8" x 2" Log Screw
N100	2	1" Hex Nut (Anchor Cable)
W100	2	1" Washer (Anchor Cable)
E3151	1	Type III Object Marker



BEST System
(Bean Eating Steel Terminal)

REV	BY	CHK	DATE	NO.
5				

REV NO. 0001 NOVEMBER 1994

REV	BY	CHK	DATE	NO.
5				

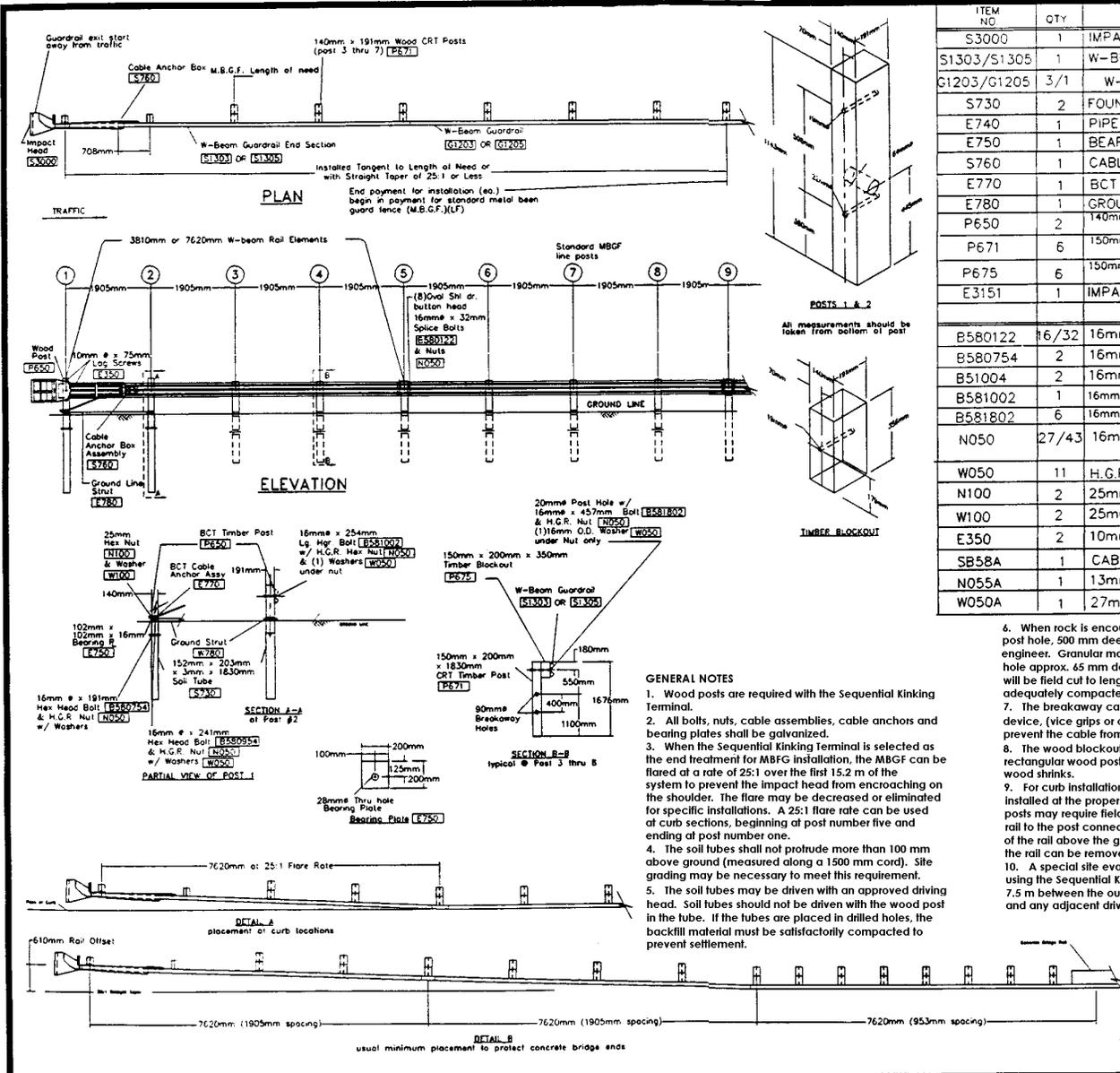


SKT

A4

Contains:

SKT Plan Sheet



ITEM NO	QTY	BILL OF MATERIALS
S3000	1	IMPACT HEAD
S1303/S1305	1	W-BEAM GUARDRAIL END SECTION 3810mm OR 7620mm
G1203/G1205	3/1	W-BEAM GUARDRAIL, 12 GA. 3810mm OR 7620mm
S730	2	FOUNDATION SOIL TUBE, 152mm x 203mm x 1830mm
E740	1	PIPE SLEEVE 1143mm
E750	1	BEARING PLATE, 200mm x 200mm x 16mm
S760	1	CABLE ANCHOR BOX
E770	1	BCT CABLE ANCHOR ASSEMBLY
E780	1	GROUND STRUT
P650	2	140mm x 190mm x 1143mm WOOD POSTS
P671	6	150mm x 200mm x 1830mm WOOD CRT POST
P675	6	150mm x 200mm x 350mm TIMBER BLOCKOUT
E3151	1	IMPACT FACE OBJECT MARKER (not shown)
HARDWARE		
B580122	16/32	16mm x 32mm SPLICE BOLT
B580754	2	16mm x 191mm HEX BOLT
B51004	2	16mm x 254mm HEX BOLT
B581002	1	16mm x 254mm H.G.R. BOLT (POST 2 ONLY)
B581802	6	16mm x 457mm H.G.R. BOLT (POST 3 THRU 6)
N050	27/43	16mm H.G.R. NUT (SPLICE 16/32, SOIL TUBES 2, STRUT 2, POST 2, 1; POST 3 THRU 6)
W050	11	H.G.R. WASHER
N100	2	25mm ANCHOR CABLE HEX NUT
W100	2	25mm ANCHOR CABLE WASHER
E350	2	10mm x 76mm LAG SCREW
SB58A	1	CABLE ANCHOR BOX SHOULDER BOLTS
N055A	1	13mm A325 STRUCTURAL NUT
W050A	1	27mm OD X 14mm ID A325 STR. WASHER

- GENERAL NOTES**
1. Wood posts are required with the Sequential Kinking Terminal.
 2. All bolts, nuts, cable assemblies, cable anchors and bearing plates shall be galvanized.
 3. When the Sequential Kinking Terminal is selected as the end treatment for MBFG installation, the MBGF can be flared at a rate of 25:1 over the first 15.2 m of the system to prevent the impact head from encroaching on the shoulder. The flare may be decreased or eliminated for specific installations. A 25:1 flare rate can be used at curb sections, beginning at post number five and ending at post number one.
 4. The soil tubes shall not protrude more than 100 mm above ground (measured along a 1500 mm cord). Site grading may be necessary to meet this requirement.
 5. The soil tubes may be driven with an approved driving head. Soil tubes should not be driven with the wood post in the tube. If the tubes are placed in drilled holes, the backfill material must be satisfactorily compacted to prevent settlement.

4. When rock is encountered during excavation, a 300 mm Ø post hole, 500 mm deep may be used if approved by the engineer. Granular material will be placed in the bottom of the hole approx. 45 mm deep to provide drainage. The soil tubes will 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. The wood blockouts should be "toe nailed" to the rectangular wood posts to prevent them from turning when the wood shrinks.
9. For curb installations, the soil tubes and posts shall be installed at the proper ground elevation behind the curb. The posts may require field drilling new holes to accommodate the rail to the post connecting bolt to maintain the proper height of the rail above the gutter pan. The excess post length above the rail can be removed if directed by the engineer.
10. A special site evaluation should be considered prior to using the Sequential Kinking Terminal where there is less than 7.5 m between the outlet side of the Sequential Kinking Terminal and any adjacent driving lane.

**SEQUENTIAL KINKING TERMINAL
(SKT-350) ASSEMBLY
2 FOUNDATION TUBE OPTION**

DRAWN BY	DATE	DWG NO.	PC	OF
LS	04/24/97	SKT-2	1	1

ROAD SYSTEMS INC.
BIG SPRING, TX
(915)-263-2435 or (815)-464-5917



SRT-350

A5

Contains:

Internet Address

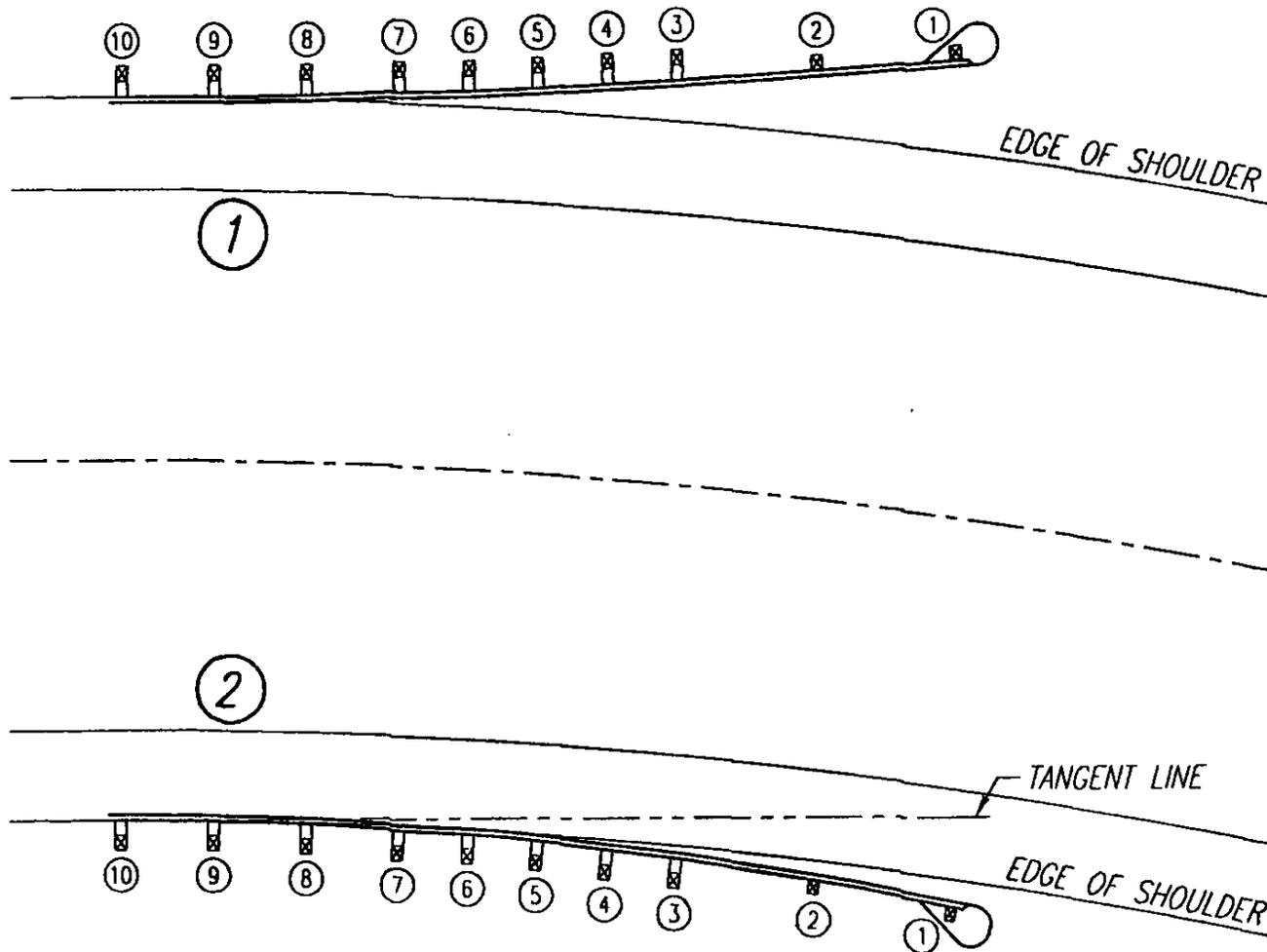
SRT-350 Plan Sheet

Layout of SRT on a Curve

Comparison Features of SRT & BCT

For general and the latest information on SRT-350, please refer to www.trin.net.

The following is in addition to the information provided at the above website.



Post Location	Post Spacing		Offset	
	mm	ft	mm	ft
10			0	0
9	1270	4'-2	15	0.05
8	1270	4'-2	60	0.2
7	1270	4'-2	150	0.5
6	952.5	3'-1 1/2	210	0.7
5	952.5	3'-1 1/2	300	1.0
4	952.5	3'-1 1/2	430	1.4
3	1905	6'-3	550	1.8
2	1905	6'-3	850	2.8
1	1905	6'-3	1220	4.0

LOCATION 1
(outside of curve)

AT LOCATION 1, THE SRT OFFSETS ARE MEASURED FROM THE EDGE OF SHOULDER FROM THE START OF THE SRT SYSTEM.

LOCATION 2
(inside of curve)

AT LOCATION 2, THE SRT OFFSETS ARE MEASURED FROM A TANGENT LINE FROM THE START OF THE SRT SYSTEM. IF AN OFFSET PLACES A POST ON THE SHOULDER, THEN THE FACE OF THE RAIL SHOULD BE PLACED ON THE EDGE OF THE SHOULDER FOR THAT OFFSET.

THE LAYOUT OF THE SRT ON A CURVE

Comparison of SRT and BCT parts

<u>Component</u>	<u>BCT</u>	<u>SRT</u>
Nose piece (Buffer end)	Same	Same
6' - 6 Cable	Same	Same
Cable Anchor Bracket	Same	Same
5-1/2" Pipe Sleeve	Same	Same
Bearing Plate	Solid	Slotted
Soil Tube	Same	Same
Soil Plate	Same	Same
Strut Assembly	None	Req'd.
First 25' -0 Guardrail	Standard	Slotted
Next 12' -6 Guardrail	Same	Same
Slot Guards	None	Req'd.
First Two Posts	Same	Same
Rest of the Posts	Standard	CRT
Blocks	Same	Same
Backup Plates	None	Req'd.
Hardware	Same	Same

Comparison of Features

Offset (4' -0)	Same	Same
Parabolic Flare	Same	Same
Location of Soil Tubes	Same	Same
Grading Req'd.	Same	Same
Tested Safety Performance	Sub '230'	NCHRP 350

SRT Features That Differ From the BCT

- * The bearing plate at post #1 is a slotted plate.
- * A strut has been added between posts #1 and #2.
- * The first 25' -0 of guardrail is slotted rail.
- * Slot guards are used at the end of the slots.
- * Posts #3 thru #10 are CRT posts and are spaced at 3' -1 1/2" spacing.
- * W-beam rail is not bolted to posts 2, 3, 4, 6, 7, 8, 9 & 10.
- * Back up plates are used at posts 2, 4, 5, 6, 7, 8, 9 & 10.



ISRT-3

A6

Information on ISRT-3

At the present time, information on ISRT-3 is not available.

We hope to have information in the near future.



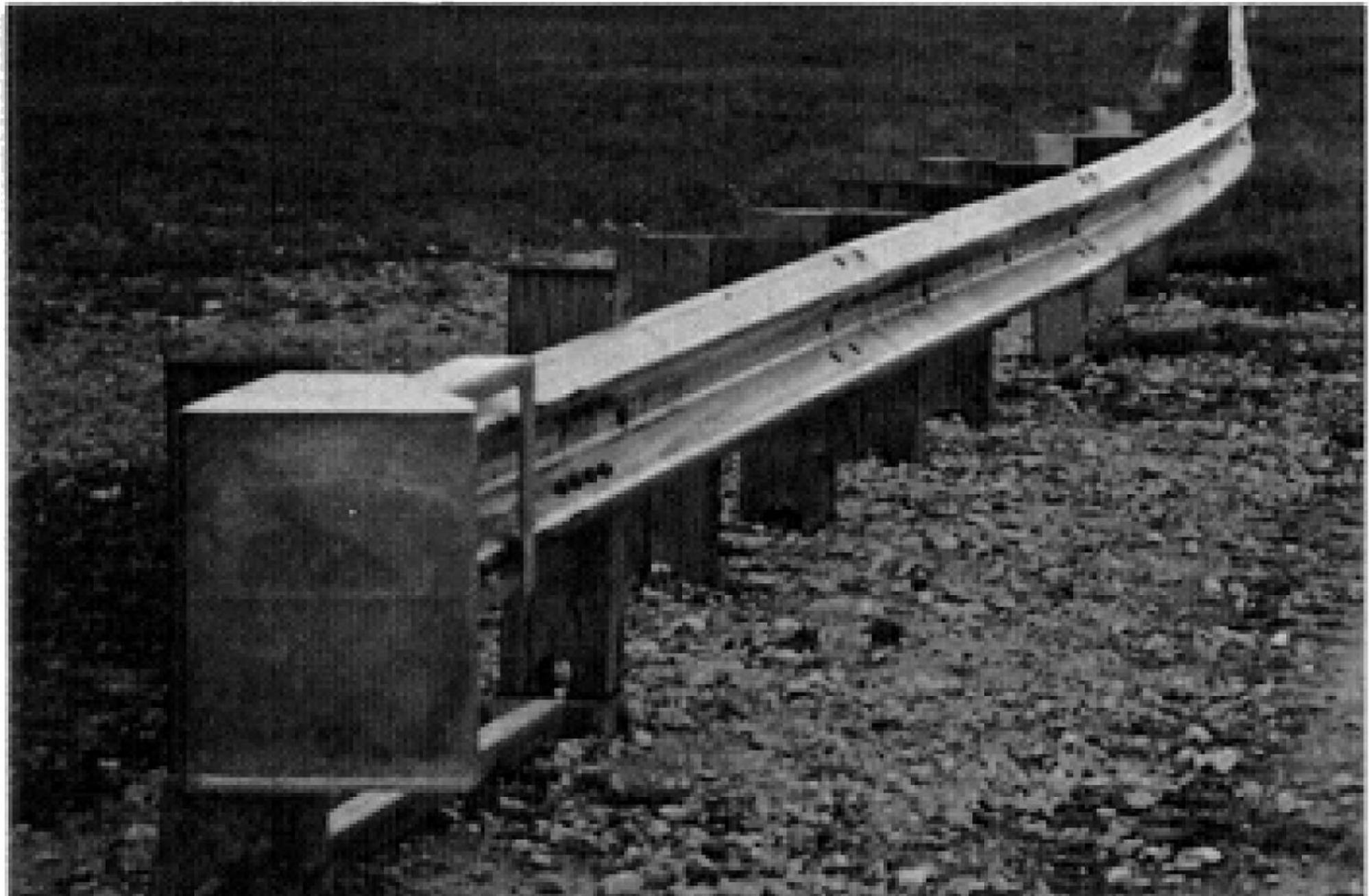
FLEAT

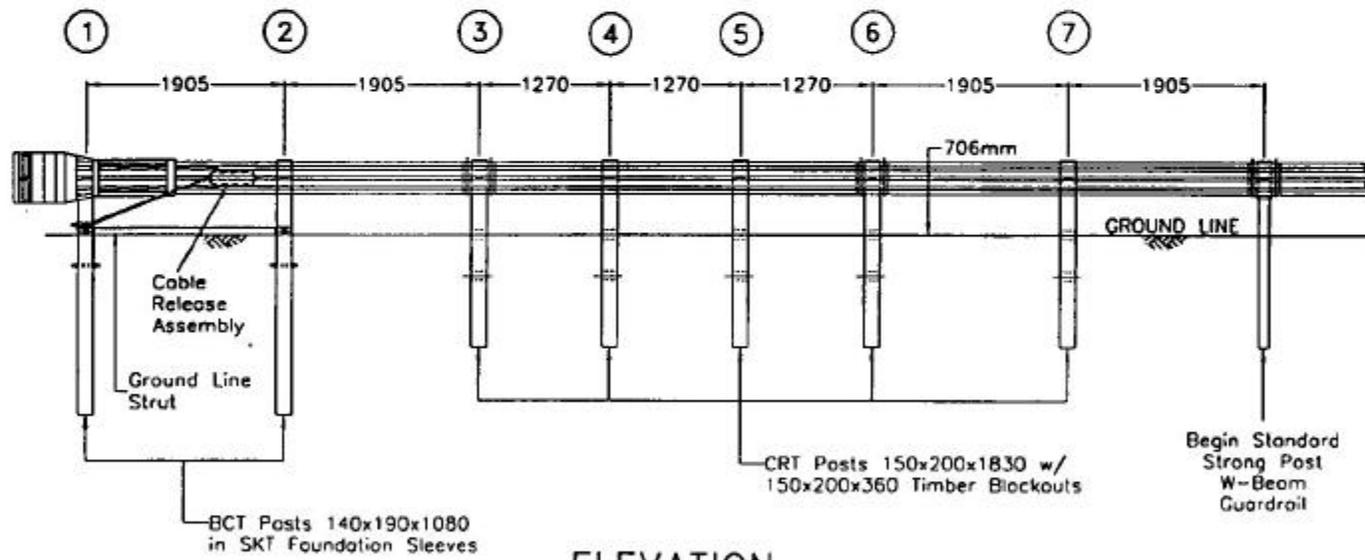
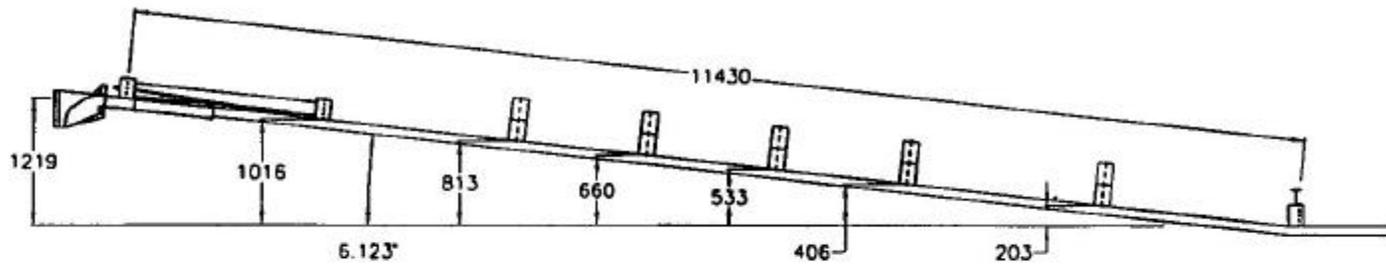
A7

Contains:

Photo of FLEAT

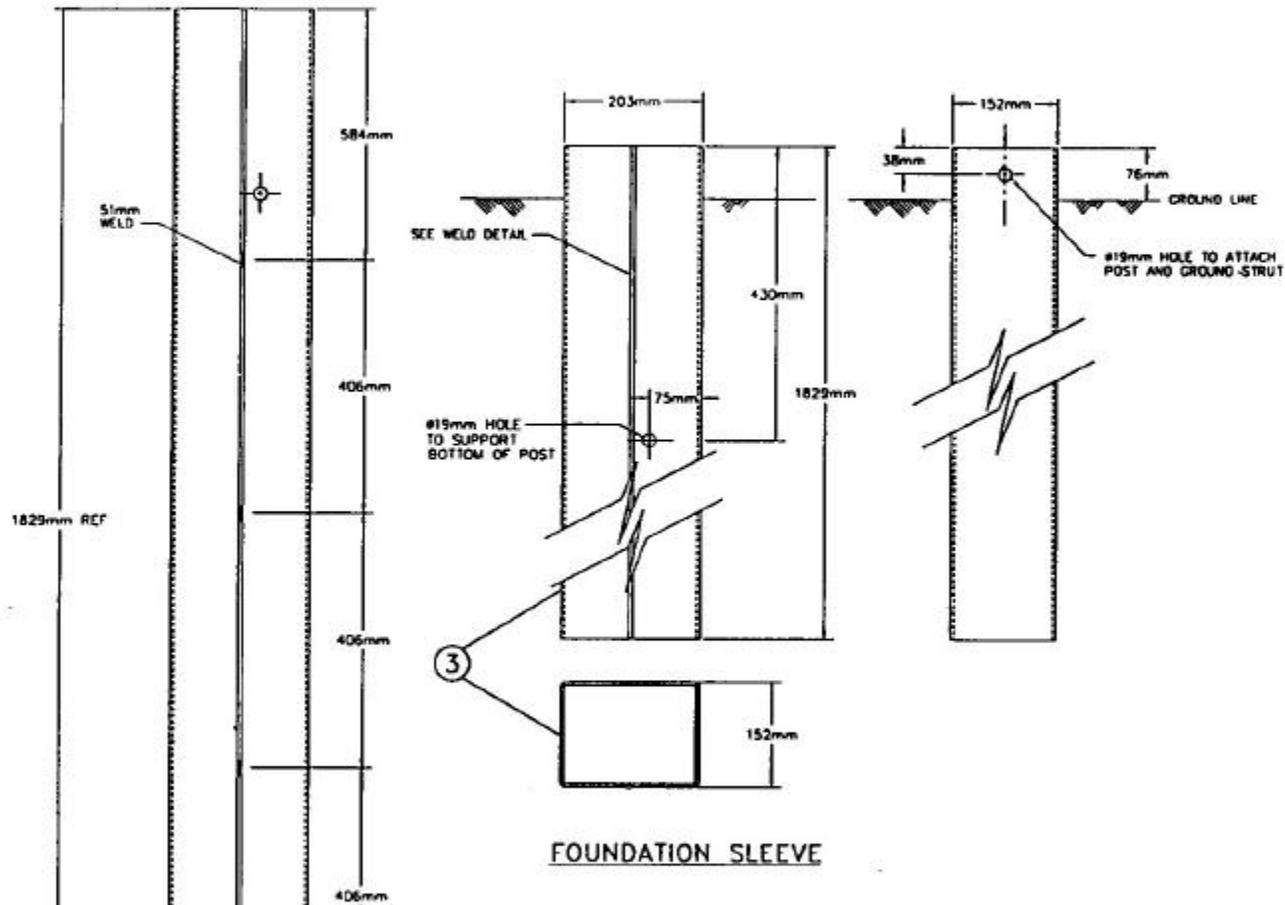
FLEAT Plan Sheet





FLARED ENERGY ABSORBING TERMINAL (FLEAT-350)			
DRAWN BY EAK	DATE 3/20/88	DESIGN SYSTEM	PC # 15
REVISIONS			

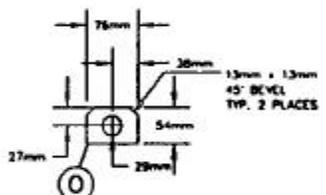
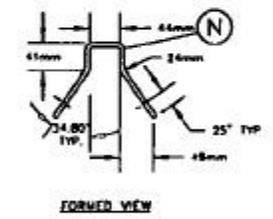
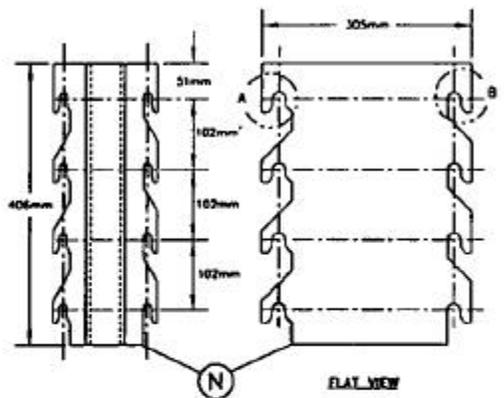
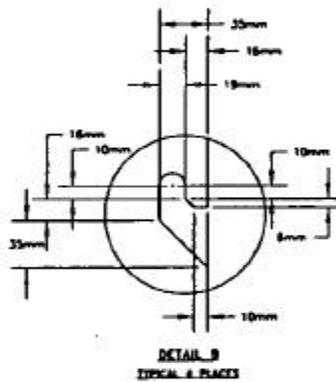
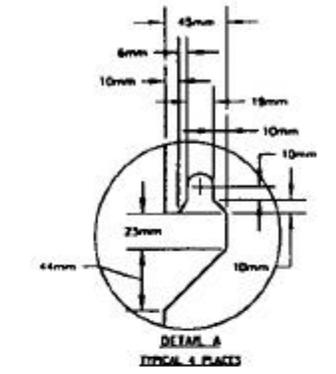
ITEM NO.	QTY	DESCRIPTION	MATERIAL
3	2	FOUNDATION SLEEVE	50 ksi 3mm PLATE



FOUNDATION SLEEVE

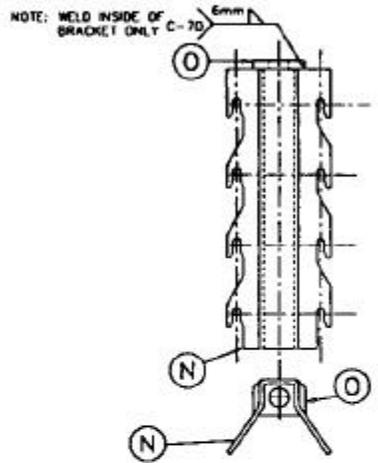
WELD DETAIL
NOT TO SCALE

FLARED ENERGY ABSORBING TERMINAL (FLEAT-350)			
FOUNDATION SLEEVE			
DESIGNED BY	DATE	REV. BY	PC. NO.
EAK	3/20/98	SYSTEM	4 5
ISSUED BY	DATE		
1	3/20/98		

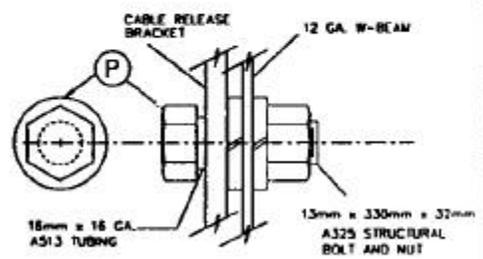


CABLE RELEASE BRACKET

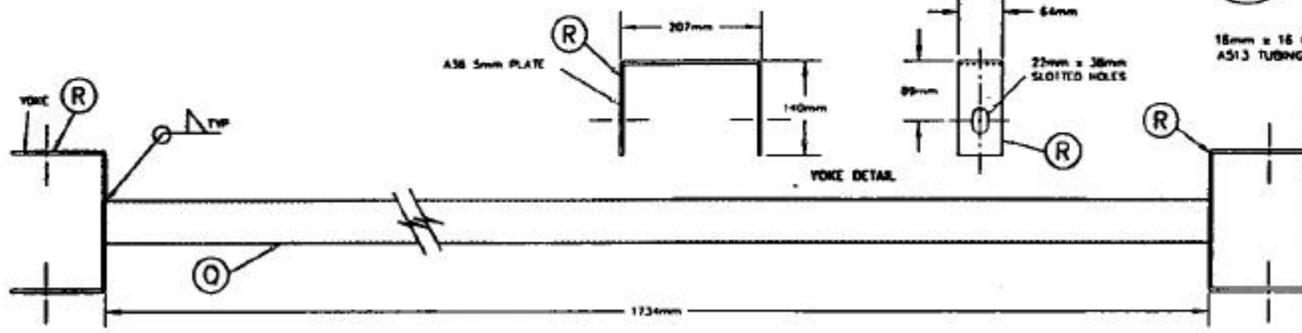
CABLE RELEASE PLATE



CABLE RELEASE ASSEMBLY



QUICK RELEASE BOLT



GROUND STRUT ASSEMBLY

ITEM NO.	QTY	DESCRIPTION	MATERIAL
N	1	CABLE RELEASE BRACKET	A36 3mm PLATE
O	1	CABLE RELEASE PLATE	A36 13mm PLATE
P	8	QUICK RELEASE BOLTS	A325
Q	1	GROUND STRUT	54mm x 54mm x 14 GA TUBING
R	2	YOKES	A36 5mm PLATE

FLARED ENERGY ABSORBING TERMINAL (FEAT-350)			
CABLE RELEASE BRACKET			
CABLE RELEASE PLATE			
SLEEVED BOLT			
GROUND STRUT			
YOKES			
DESIGNED BY	DATE	REV. BY	REV. NO.
EAK	3/20/98	SYSTEM	5 5
ISSUED BY	DATE		
	3/20/98		



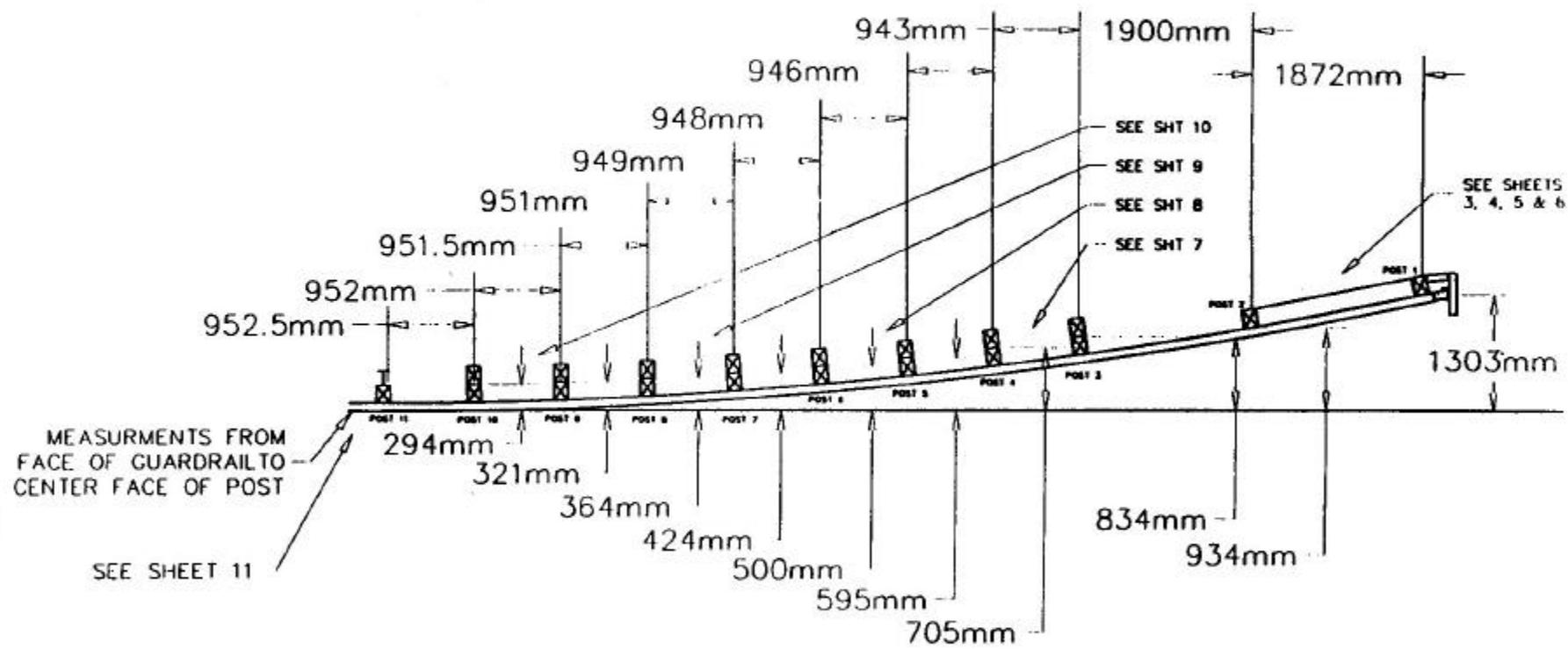
REGENT

A8

Contains:

REGENT System Layout

PARTS LIST	
ITEM	DESCRIPTION



REGENT SYSTEM LAYOUT

DESIGNER JW	DATE 5/26/98	REGENT SYSTEM REGENT SYSTEM PLAN WF POST & TIMBER BLOCK
SCALE 1=1	RS 2 WF	
TOLERANCES a Angular ± 1° b Linear ± 3mm (UNLESS OTHERWISE NOTED)		



ROSS-350

A9

Contains:

ROSS-350 Photos

ROSS-350 Installation Instructions

ROSS-350 Installation Checklist

ROSS-350 Maintenance Instructions

Differences of ROSS-350 & SRT-350

ROSS-350 Plan Sheet

ROSS-350™

SRT-350 FAMILY - LATEST ADDITION



SYRO ROSS-350 (Reduced Offset Slotted System™)

The Newest Member of
the SYRO SRT 350 Family
of Flared End Treatments

Approved by FHWA per
letter dated 18 June 1998
(referred to as ISRT-3).

 **Trinity Industries, Inc.**

(800) 844-SYRO (7976)
Fax: (214) 589-8423
Email: eastons@corpms1.trin.net
Website: www.trin.net/syro

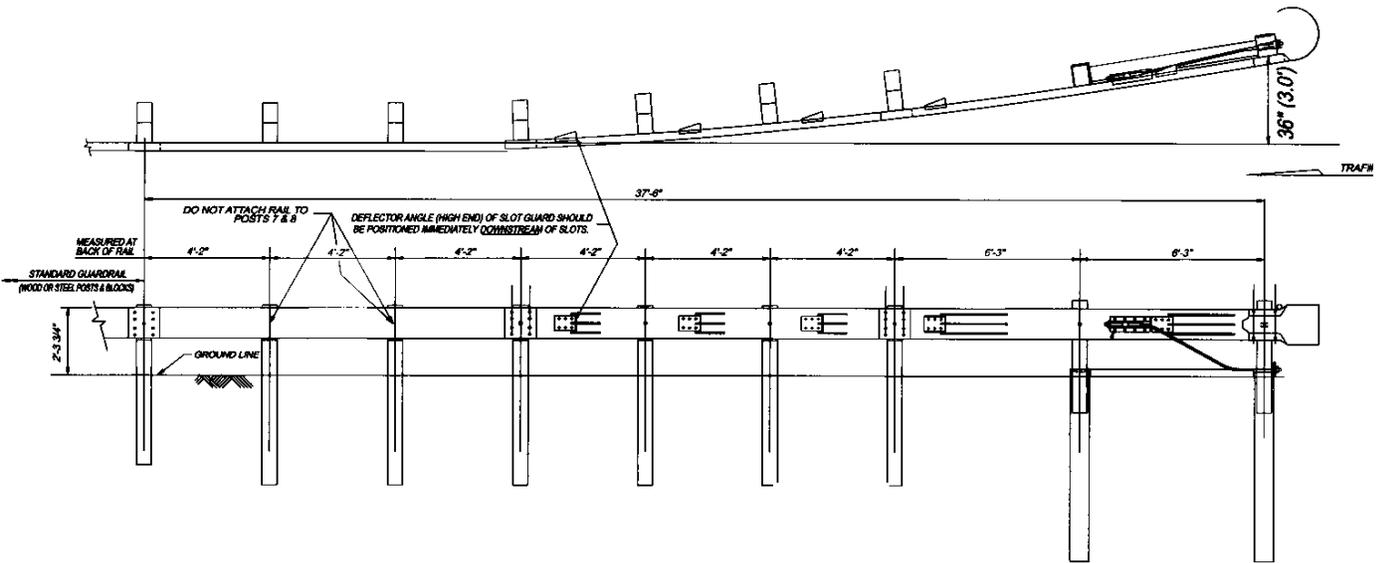
Just in time for October, 1998, compliance deadline
for use of "350" products...

The SYRO ROSS-350 Offers Specifiers, Installers and Users All These Advantages:

- 3'0" Offset Means Installation Cost Savings.
- Significant Construction Cost Savings with Reduced Offset Due to Less Grading to Meet FHWA Minimum Standards.
- Small Buffer End Results in Lower Repair Costs-vs-Light Gage Extruding Head of Other Flared Terminals.
- Familiar Configuration Means Easier Installation.
- Installation Instructions and Field Training available for Your Convenience.

*Trinity has facilities across America to Serve Your
Needs at Competitive Prices*

ROSS-350™

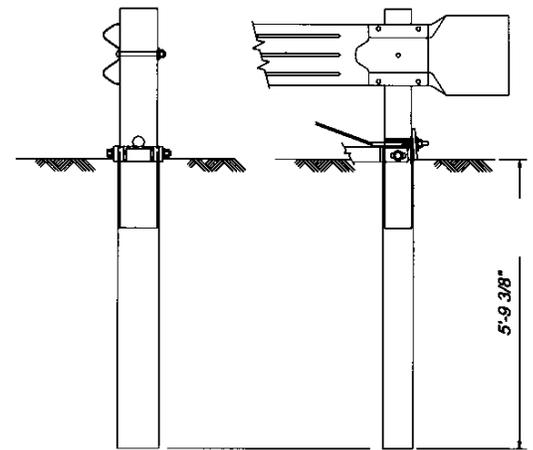


REDUCED OFFSET SLOTTED SYSTEM

Offset	3'-0" (915mm)
Length	37'-6" (11 430mm)
No. of Posts	8

Reduced:

- Earthwork
- Number of Parts
- Price
- Installation Costs



Highway Safety Systems Division

Facilities & Offices:

Birmingham, AL	Fort Worth, TX
Centerville, UT	Girard, OH
Dallas, TX	Hamburg, NY
East Hartford, CT	Lima, OH
Elizabethtown, KY	Sunbright, TN
Flint, MI	

NCHRP Report 350, Test Level 3 Products available from Trinity Industries:

- ET-2000 Family (Tangent Guardrail Terminal)
- CAT-350 (Crash Cushion)
- SRT-350 Family (Flared Guardrail Terminal)
- ADIEM-II (Crushable Concrete Crash Cushion)
- MPS-350 (Truck Mounted Attenuator)

Trinity Industries, Inc. is the complete source for your highway safety product needs. Trinity has extensive manufacturing resources throughout the United States to help meet any requirements. Trinity also offers classroom and field training to assist your personnel with all of our highway safety systems.



ROSS-350™ and Reduced Offset Slotted System are trademarks of Trinity Industries, Inc.

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INSTALLATION INSTRUCTIONS
FOR
SYRO ROSS-350
(3' - 0 Flared System)

MATERIALS

As packaged, your ROSS-350 system includes all materials needed for the installation of the 11 403 mm (37' 6) of the system. Note that no concrete footings or foundations are required.

TOOLS REQUIRED

Tools required are those ordinarily used to install standard highway guardrail (HGR). They include 9/16", 15/16", 1-1/4" and 1-1/2" sockets, wrenches, and such other equipment as augers and post pounders commonly used in driving posts.

INSTALLATION

NOTE: The installation of the ROSS-350 is very similar to other parabolic flared terminals (ie: SRT, BCT, MELT, etc.). The same equipment and expertise is required for these systems. Anyone with experience installing flared terminals should have no difficulty installing the ROSS-350.

Post Layout

Start at the end of the guardrail run (connection point for the terminal). The length of the installation is 11 403 mm (37' 6).

Layout the post locations starting at location 8 which is the first post in the system. Posts 7 and 8 are in line (tangent) with the guardrail installation. Use the following table to offset posts 1 thru 6: (dimensions are to the center of the traffic face of the blockouts, except measure from the face of posts 1 & 2 which have no blockouts). The offset points are measured from a tangent line of the guardrail run extending from post 9 towards post 1. Offset points are to be located by chord measurements at the back of the rail equal to the nominal post spacings. Posts are to be approximately tangent to the railing at each post location.

Post location	Post spacing		Offset	
	mm	ft.	mm	ft.
9			0	0
8	1270	4' - 2	0	0
7	1270	4' - 2	0	0
6	1270	4' - 2	20	0.1
5	1270	4' - 2	75	0.2
4	1270	4' - 2	170	0.6
3	1270	4' - 2	300	1.0
2	1270	4' - 2	565	1.9
1	1270	4' - 2	915	3.0

Installing the Posts

Install the wood posts at locations 3 thru 8. these posts (PC-4063B) may be driven. They may also be installed by drilling holes approximately 1120 mm (44") deep. Insert the 1830 (6' 0) wood post into these holes and backfill. Note that, in either case, the center of the upper 90 mm (3-1/2") hole in the post is at ground level and these posts are spaced at 1270 mm (4' - 2) intervals.

Foundation Tubes Options

Option 1 6' - 0 Tube no Soil Plate

No assembly required. Install the soil tube as described below.

Option 2 4' - 6 Tube with Soil Plate

Assemble the soil tubes and soil plates. Bolt the soil plates (PC-766G) to the foundation tubes (PC-740G) with two 16 mm x 190 mm (5/8" x 7-1/2") hex bolts (PC-3478G) and two HGR nuts (PC-3340G), no washers. **DO NOT OVERTIGHTEN AND DEFORM THE TUBES.**

Placing Foundation Tubes

Install the foundation tubes at locations 1 and 2. Note that the soil plate (if used) should be positioned on the downstream side of the post.

DO NOT DRIVE TUBES WITH WOOD POST INSERTED.

Installation options (best preference listed first):

- A) If the soil is permeable, so water will drain from the tubes, the tubes may be driven with an approved driving head.
- B) For non-permeable soil, drill a 305 mm (12") pilot hole approximately 1450 mm (57") deep and force the soil plate/tube assembly to the appropriate depth by impact or vibratory means with an approved driving head.
- C) Same as method 2, except the slots for the soil plates (if used) may be cut out by using a rock bar.
- D) Same as method 2, except drill three adjacent 305 mm (12") holes or one 610 mm (24") hole to accommodate the soil plate/tube assembly. Extra care must be taken to prevent settlement or lateral displacement of the tubes.

Optional Installation as defined by the Governing Specifications:

- A) The installer may elect (if it is an option provided by the governing specifications) to eliminate the soil plates and place the tubes in a 460 mm (18") hole, approximately 1450 mm (57") deep and backfill with concrete. Prior to installing the tubes, approximately 65 mm (2-1/2") of granular material shall be placed at the bottom of the hole to prevent the concrete from sealing the bottom of the tube and prevent it from draining.

The finished guardrail height will generally be 700 mm (27-1/2") above the edge of the shoulder. Site grading may be required to prevent the tubes from projecting more than 100 mm (4") above the ground line.

Installing Wood Posts

Insert pipe sleeve (PC-705G) in post (PC-4147B) and install in steel tube at location 1.

Install other 1145 mm (3' 9") (PC-4147B) post in steel tube at location 2.

Installing the Strut

Place the slotted yokes of the ground strut (PC-9852A) over the foundation tubes (PC-736G) at the base of posts 1 and 2. A 16 mm x 240 mm (5/8" x 9-1/2") hex bolt (PC-3497G), a hex nut (PC-3340G), and two round washers (PC-3300G) are used to attach the strut to the foundation tube. Note that the bolt goes through the strut, the foundation tube and the wood post.

DO NOT OVERTIGHTEN AND DEFORM TUBES.

Installing Wood Blockouts and Guardrail

Note: Do not bolt the guardrail panels to posts 7 and 8.

At post locations 7 and 8 bolt the wood blockouts (PC-45075B) to the wood posts (PC-4063B) using a 16 mm x 460 mm (5/8" x 18") post bolt (PC-3580G), a hex nut (PC-3340G), and a round washer (PC-3300G). The washer is installed between the wood post and the nut.

Install 3810 mm (12' 6) guardrail panel (PC-9G) from location 9 to location 6, splice bolted and post bolted to the standard run of guardrail with hardware provided by the standard guardrail provider.

Install the next 3810 mm (12' 6) guardrail panel (PC-37G) from location 6 to location 3 with eight (8) 16 mm x 32 mm (5/8" x 1-1/4") splice bolts (PC-3360G) and hex nuts (PC-3340G).

At posts 4, 5 and 6, bolt the rail to the post and block with a 16 mm x 460 mm (5/8" x 18") post bolt (PC-3580G), a hex nut (PC-3340G) and a round washer (PC-3300G).

NOTE: Slot orientation. Guardrail panel PC-37G has three (3) sets of slots. Guardrail panel PC-34G has two (2) sets of slots and holes for the cable anchor bracket. Both guardrail panels should be installed so that the slot guard attachment holes are at the end of the slots away from the end of the terminal. The cable anchor bracket holes on PC-34G will be between post 1 and post 2.

Set the last guardrail panel (PC-34G) into place. Connect the two guardrail panels together at the splice with eight (8) 16 mm x 32 mm (5/8" x 1-1/4") splice bolts (PC-3360G) and hex nuts (PC-3340G). Bolt the rail to the posts at locations 1 and 2 by using a 16 mm x 255 mm (5/8" x 10") post bolt (PC-3500G), a hex nut (PC-3340G), and a round washer (PC-3300G). The round washer is installed between the wood post and the nut.

Installing Slot Guards

Install the slot guards (PC-9959G) at the locations shown on the drawings. Slot guards are installed on the downstream end of the slots (the deflector angle should be closest to the elongated slots). Each slot guard is bolted to the backside of the guardrail panels with six (6) 16 mm x 32 mm (5/8" x 1-1/4") splice bolts (PC-3360G) and hex nuts (PC-3340G).

Installing the Cable Anchor Assembly

The cable anchor bracket (PC-700A) is bolted to the backside of the guardrail panel (PC-34G) using eight (8) 16 mm x 38 mm (5/8" x 1-1/2") hex bolts (PC-3380G), eight (8) hex nuts (PC-3340G), and eight (8) round washers (PC-3300G). The round washers are installed between the bolt head and the guardrail on the face (traffic) side.

Slide one end of the cable (PC-3000G) into the cable anchor bracket (PC-700A) and the other end through the sleeve (PC-705G) in post 1. Place the bearing plate (PC-775G) with the open side of the V-notch pointing upward and connect it to post 1 by driving two (2) nails (PC-5968G), through the holes provided, bending the nails to attach the bearing plate. Place the plate washer (PC-9961G) on the end of the cable.

Secure both ends of the cable assembly with 25 mm (1") hex nuts (PC-3910G) and tighten. Restrain cable with vise grips at the end being tightened to avoid twisting the cable. Make sure the nuts are tight and the cable is taut.

Installing the End Section

Install the end section (PC-907G) by connecting it to the end of the guardrail panel with four (4) 16 mm x 32 mm (5/8" x 1-1/4") splice bolts (PC-3360G) and hex nuts (PC-3340G).

SRT-350
INSTALLATION CHECK LIST

1. The rail height is in accordance with the plans (generally 706 mm [27-3/4"] above the edge of the shoulder).
2. The steel tubes do not protrude more than 100 mm (4") above the ground line.
3. The bolts at the top of the steel tubes are not overtightened and collapsing the walls of the steel tubes.
4. The 150 mm x 200 mm (6" x 8") bearing plate at post 1 is correctly positioned and the anchor cable is taut and correctly installed (it should be re-checked after installation to make sure it hasn't slackened).
5. The guardrail is not attached to the posts at locations 7 and 8.
6. No rectangular washers are used on the face of the rail.
7. Slot guards are in place and oriented correctly.
8. Guardrail panels are oriented correctly.

Maintenance Instructions
for
SYRO ROSS-350

Maintenance of the ROSS can be categorized as routine or repair.

Routine maintenance consists of periodically checking the system to see that the cable is taut, the nuts have not been removed from the cable, and the blockouts have not rotated.

Repair maintenance deals with the system after it has been hit. Most hits on the ROSS will require the replacement of 3/81 M (12' 6") to 11.43 M (25' 0") of rail and broken posts, depending on the severity of the hit. The following steps should be taken in making the repairs:

- (1) Check the anchor cable and bracket for damage. The bearing plate, nuts, washers and anchor bracket are rarely damaged.
- (2) Make note of the number of broken posts and wood blockouts that need to be replaced, along with any damaged bolts. Inventory and pick up the reusable parts. Bring necessary replacement parts from the maintenance yard.
- (3) The two new slotted pieces (PC-34G; and PC-37G) brought to the repair site should have the slot guards (PC-9959G) already bolted to them to minimize work zone repair time. The slot guards on the damaged rail can be removed back at the maintenance yard.
- (4) Disconnect and remove the damaged rail from the posts.
- (5) Remove the broken posts in the steel tubes using one of the two post removal tools recommended that can be assembled from "off the shelf hardware" items. Pound the steel pipe assembly or screw the lag screws into the top of the broken post and remove the remains of the broken post by pulling on the chain. If necessary, place a steel rock bar in the loop of the chain and use it as a lever arm to remove the post.
- (6) Remove broken posts not installed in steel tubes.
- (7) After the site has been cleared of damaged debris, the system can be reconstructed following the construction installation instructions, at the front of this manual.

ROSS - 350 Differences from SRT - 350 (9-Post)

	<u>ROSS - 350</u>	<u>SRT - 350 - 9</u>
Offset	3'-0 (0.9 m)	4'-0 (1.2 m)
Length of Flare	29'-3 (8.9 m)	37'-6 (11.4 m)
Length of System	37'6 (11.4 m)	37'6 (11.4 m)
Number of Posts	8	9
Number of Sets of Slots	5	4
Not Bolted at Posts:	7,8	2,3,4,6,7,8, & 9
Back up Plates	0	5 or 6*
Slot Guards	new (5)	Old (4)
Soil Tube	6'-0 (1.8 m)**	5'-0 (1.5 m)
Soil Plate	No**	Yes
End Section	Small Buffer	One Piece Wrap Around

* Depending on 25'0 or 12.5' Option
** Option for 4'6 Tubes with Soil Plates



C-A-T 350

B1

Contains:

Internet Information

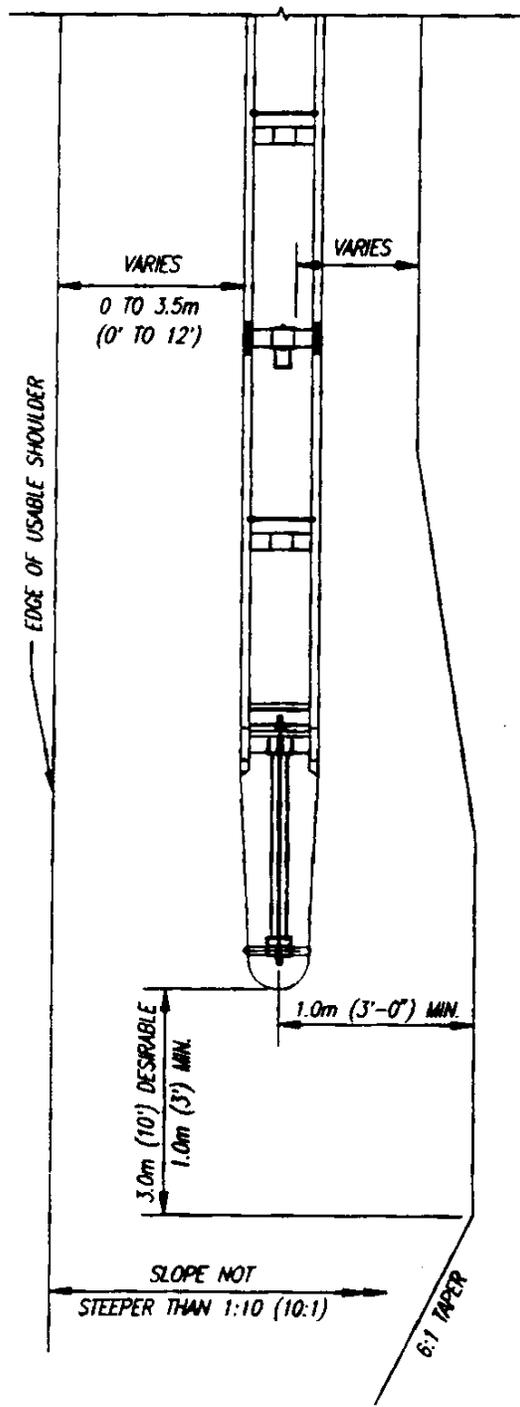
CAT Plan Sheet

CAT on Shoulder

CAT in Median

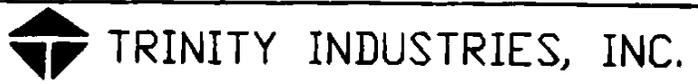
For general and the latest information on C-A-T 350, please refer to www.trin.net.

The following is in addition to the information provided at the above website.



NOTE: THE SLOPE BEYOND THE SHOULDER PAD SHOULD BE TO THE STATES STANDARDS OR THE SLOPE REQUIRED BY THE BENEFIT COST ANALYSIS IN THE "AASHTO ROADSIDE DESIGN GUIDE" FOR SLOPES.

MATERIAL:

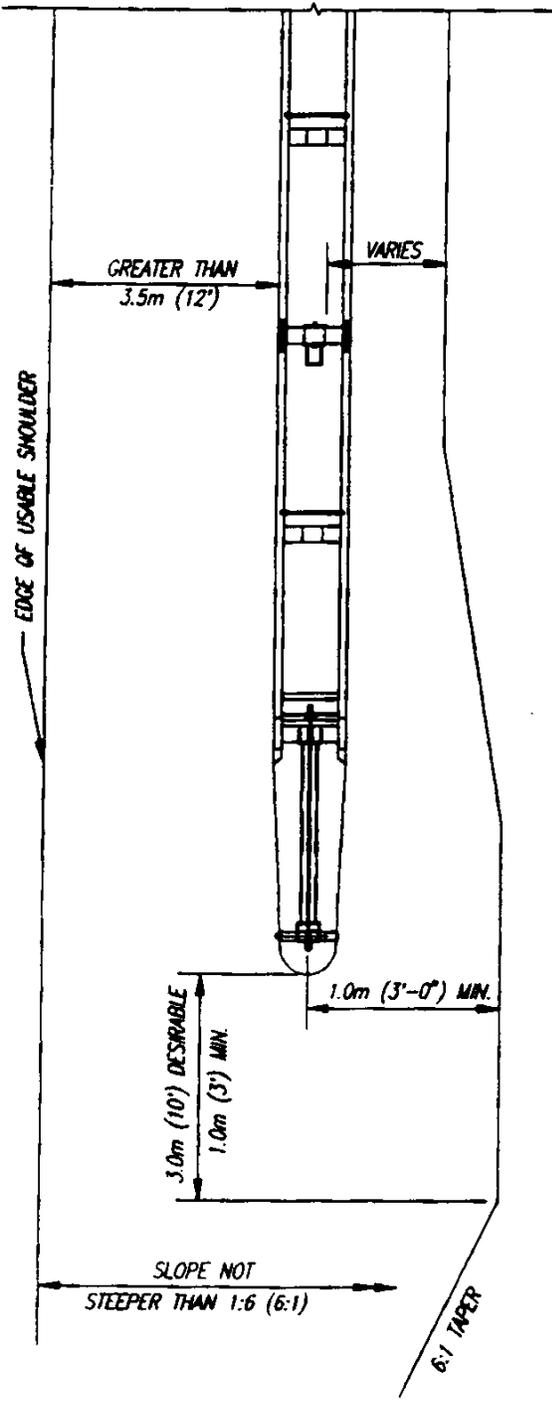


PROPERTY OF TRINITY INDUSTRIES INC. AND NOT TO BE REPRODUCED WITHOUT THEIR PERMISSION

CAT ON SHOULDER
CASE 1

MK	BY	DATE	REVISION

DRAWN: FLD	CHKD: T.P.	APP:	DATE: 12/12/94
DRAWING NO:			REV.
			SIZE A



NOTE: THE SLOPE BEYOND THE SHOULDER PAD SHOULD BE TO THE STATES STANDARDS OR THE SLOPE REQUIRED BY THE BENEFIT COST ANALYSIS IN THE "AASHTO ROADSIDE DESIGN GUIDE" FOR SLOPES.

MATERIAL:

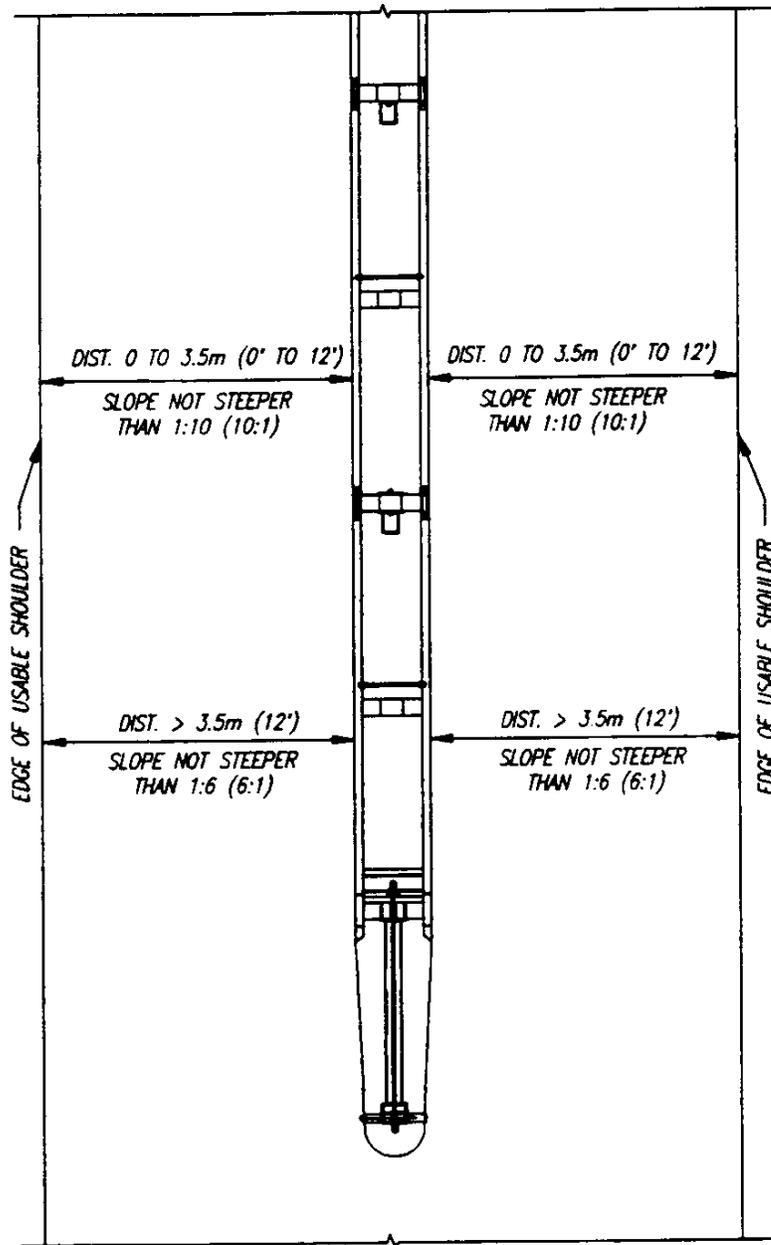


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CAT ON SHOULDER
CASE 2

MK	BY	DATE	REVISION

DRAWN: FLD	CHKD: T.P.	APP:	DATE: 12/12/94
DRAWING NO:			REV. SIZE A



MATERIAL:



TRINITY INDUSTRIES, INC.

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CAT IN MEDIAN
CASE 3

MK	BY	DATE	REVISION

DRAWN: <i>FLD</i>	CHKD: <i>T.P.</i>	APP:	DATE: <i>12/12/94</i>
DRAWING NO:			REV. SIZE A



BRAKEMASTER

B2

Contains:

Internet Information

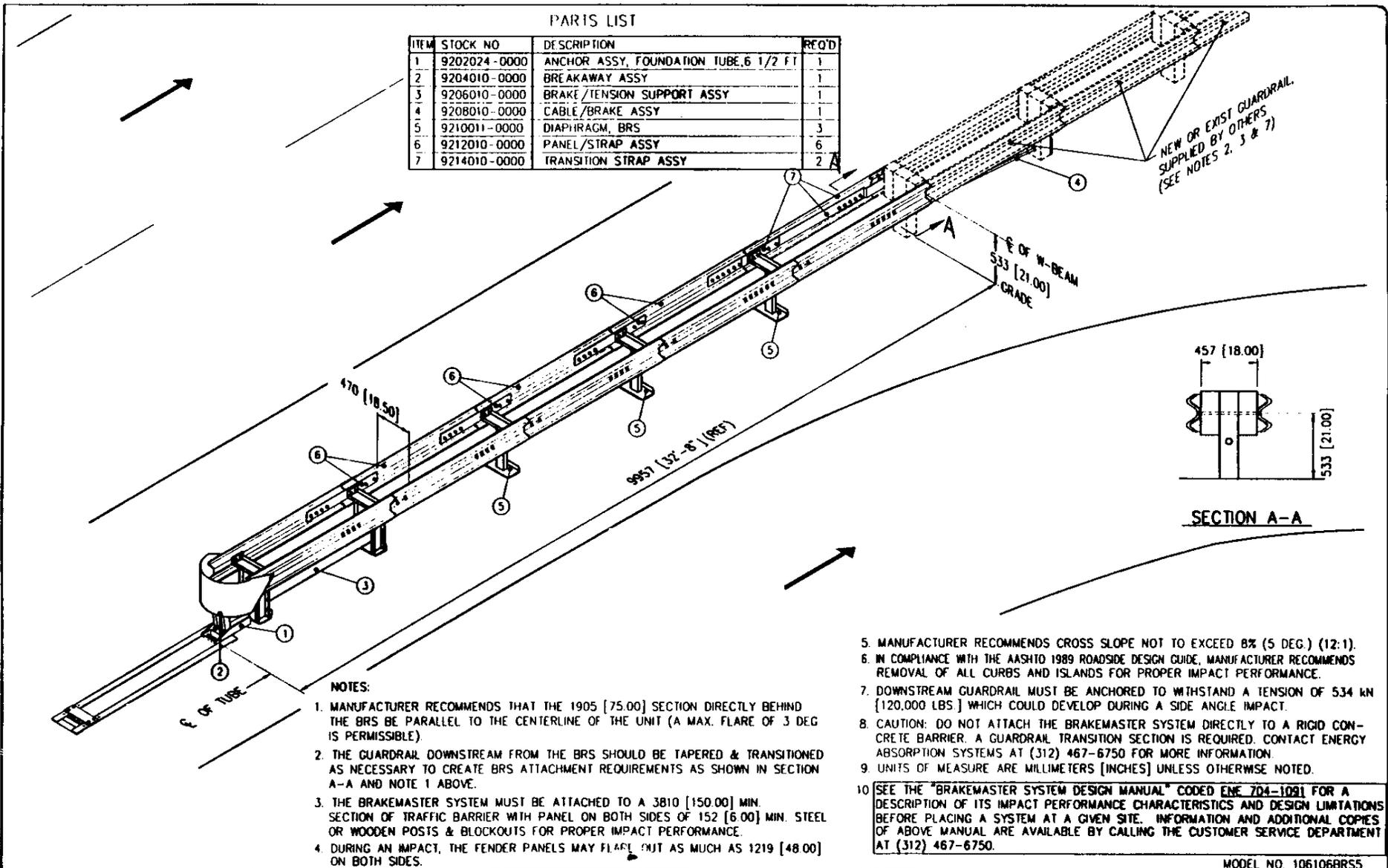
BRAKEMASTER General Assembly

For general and the latest information on Brakemaster, please refer to www.energyabsorption.com.

The following is in addition to the information provided at the above website.

PARIS LIST

ITEM	STOCK NO	DESCRIPTION	REQ'D
1	9202024-0000	ANCHOR ASSY, FOUNDATION TUBE, 6 1/2 FT	1
2	9204010-0000	BREAKAWAY ASSY	1
3	9206010-0000	BRAKE/TENSION SUPPORT ASSY	1
4	9208010-0000	CABLE/BRAKE ASSY	1
5	9210011-0000	DIAPHRAGM, BRS	3
6	9212010-0000	PANEL/STRAP ASSY	6
7	9214010-0000	TRANSITION STRAP ASSY	2



Revisions	Date	Rev	By	Ckd	App	DESIGN SPEED ^{BY KM/H} (60 MPH) M.P.H
ADDED NOTE: 2005 TENSION ASSY TO METRIC	11/29/89	A	DBS	WCK		
ADDED NOTE: 2005 TENSION ASSY TO METRIC	11/29/89	B	DBS	SPT		
ADDED NOTES	11/29/89	C	ST	SPT		
ATTACHMENT REF WAS 92-00-08	11/29/89	D	ST	SPT		
ADDED METRIC & DESIGN MANUAL NO'S	11/29/89	E	DBS	BB		
NEW NOTES	11/29/89	F	ST	SPT		
ADDED STEEL OR WOODEN TO NOTE 3	11/29/89	G	ST	SPT		
ADDED SH1 2. MANUAL CODE WAS 0591	11/29/89	H	ST	SPT		
CHGD TO METRIC	11/29/89	I	DBS	BB		
REV'D TO SHOW FOUND. TUBE ANCHOR	1/6/90	J	ST	WCK		
REV'D FOUND TUBE ANCHOR ASSY	1/6/90	K	ST	WCK		

DESIGN SPEED ^{BY KM/H} (60 MPH) M.P.H

AVERAGE G's

EST. FORCE ON BACKUP STRUCTURE _____ KIPS

Project No. _____ Sales Order No. _____

Serial No. _____ Color _____

Designed _____

Drawn *J.B. Welch* 6/27/89

Checked *B.B.B.* 11/13/89

Approved *W b Xscape* 3/1/90

NOSE SECTION 92-00-03

FRONT SECTION 92-00-04

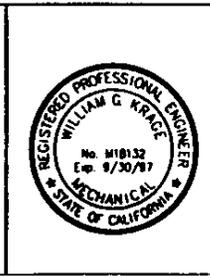
MIDDLE SECTION 92-00-05

REAR SECTION 92-00-06

ANCHOR ASSY 9202024-0000

ATTACHMENTS 92-03-09

NEXT ASSEMBLY



MODEL NO. 106106BR55

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

BRAKEMASTER®
GENERAL ASSEMBLY
(UNIDIRECTIONAL SYSTEM)

DATE (1:32) 3/8"=1'-0" DR C Dwg. NUMBER 92-00-01 SHEET 1 OF 2 REV. K



QUADGUARD

B3

Contains:

Internet Information

QUADGUARD Photos

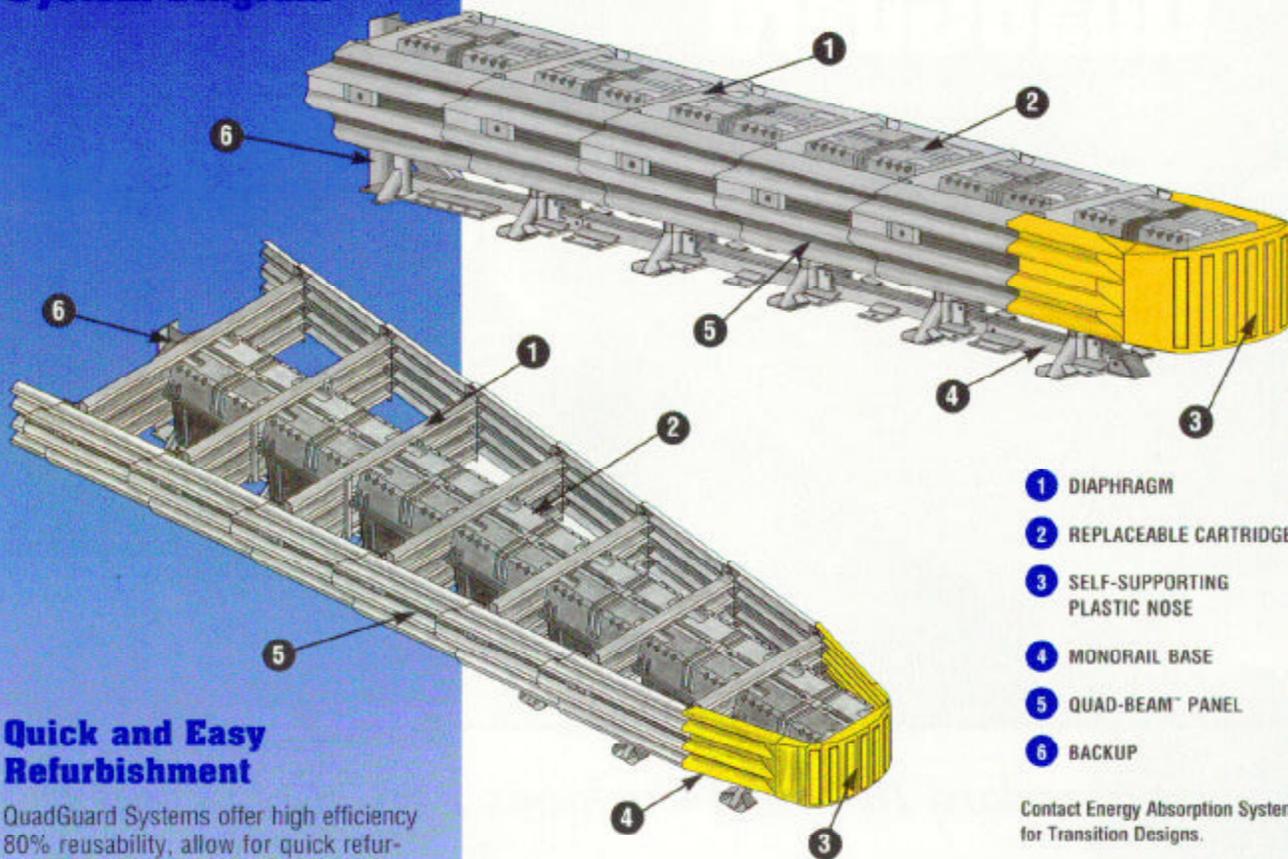
QUADGUARD Design Criteria

QUADGUARD Plan Sheets

For general and the latest information on QuadGuard, please refer to www.energyabsorption.com.

The following is in addition to the information provided at the above website.

System Diagram



- 1 DIAPHRAGM
- 2 REPLACEABLE CARTRIDGE
- 3 SELF-SUPPORTING PLASTIC NOSE
- 4 MONORAIL BASE
- 5 QUAD-BEAM™ PANEL
- 6 BACKUP

Contact Energy Absorption Systems, Inc.,
for Transition Designs.

Quick and Easy Refurbishment

QuadGuard Systems offer high efficiency 80% reusability, allow for quick refurbishment and keep repair costs low. After a head-on impact, typically only the cartridges and plastic nose are expended. The cartridges contain the debris, further reducing refurbishment time.



General Specifications

The following are general specifications for the QuadGuard System. Additional information is available in the Design, Installation and Maintenance Manuals for this system. Contact Energy Absorption Systems, Inc., for details.

Minimum Width at Backup:	610 mm (2')
Maximum Width at Backup:	2286 mm (7' 6")
Weight (typical 6-bay unit):	1020 kg (2255 lb)
Length (typical 6-bay unit):	6.4 m (21')



**ENERGY ABSORPTION
SYSTEMS, INC.**

Saving Lives by Design

One East Wacker Drive Chicago, Illinois 60601-2076
Telephone: (312) 467-6750 Fax: (312) 467-1356
Internet: www.energyabsorption.com

Engineering and Manufacturing Facilities:
Rocklin, California and Pell City, Alabama

Form#: ENE851-8/97

Distributed by:

The QuadGuard™ System

Design Criteria

FHWA Criteria

The QuadGuard System has been fully tested to NCHRP 350 TL-3, Redirective, Non-gating, Terminals and Crash Cushions Standards and has been approved by the FHWA.

Length

The design speed of the roadway determines the system length. See Table A: Design

Width

The width you select will depend upon the width of the hazard you are shielding. As a general rule, selection of the narrowest width that adequately shields the hazard is recommended.

Other Factors That May Affect Your Design:

1. The existence of drain inlets.
2. Junction boxes or other appurtenances located near the hazard.
3. Insufficient space for the length preferred.
4. The location and movement of expansion joints. Generally, the presence of these items does not present a problem, but contact Energy Absorption Systems Customer Services Department before proceeding with your design. For Customer Service call

1-888-32-ENERG.

Table A: Design

NCHRP 350 Test Level	Design Velocity kph [mph]	Number of Bays	Effective Length m [ft]	Number of Cartridges	
				Type I Front of System	Type II Rear of System
	40 [25]	1	1.74 [5.75]	2	0
TL-1	50 [31]	2	2.66 [8.75]	2	1
	60 [37]	2	2.66 [8.75]	2	1
TL-2	70 [44]	3	3.57 [11.75]	2	2
	80 [50]	4	4.49 [14.75]	3	2
TL-3	90 [56]	5	5.40 [17.75]	3	3
	100 [62]	6	6.32 [20.75]	4	3
	100 [62]	7	7.23 [23.75]	4	4
	110 [68]	8	8.15 [26.75]	4	5
	115 [71]	9	9.06 [29.75]	4	6
	115 [71]	10	9.98 [32.75]	5	6
	115 [71]	11	10.89 [35.75]	5	7
	120 [75]	12	11.81 [38.75]	5	8

Special Site Conditions

Contact Energy Absorption Systems Customer Service Department if you would like assistance with your application. You will need to answer the following questions:

1. Are curbs, islands or elevated objects (delineators or signs) present at the site? What height and width are they? All curbs and elevated objects over 100mm [4in] high should be removed. If possible, curbs under 100mm [4in] high should be removed approximately 15m [50ft] in front of the QuadGuard™ System, and as far back as the system's backup. Any curbs that must remain should be 100mm [4in] maximum and be mountable.
2. Is the system to be placed on existing concrete? If so, the concrete must be at least 150mm [6in] thick, reinforced 28MPa [4000psi] portland cement concrete (P.C.C.) and in good condition or 200mm [8in] thick non-reinforced. Otherwise, a new concrete pad must be placed to properly secure the system.
3. What is the hazard? In addition to the hazard's width, other factors need to be considered, such as the height and material of the hazard. Is it concrete or steel? The backup attachment design is dependent on these factors.
4. If the installation site is a gore area, (place where two roads diverge), what is the angle of divergence?
5. What is the general geometry of the site, including the roadway for 150m [500ft] in front, so traffic patterns can be visualized?
6. Is there a cross slope? If there is a cross slope of more than 8% (5°) or if the cross slope varies more than 2% (1°) over the length of the system, a concrete leveling pad may be required. (See Figure 4)
7. When there is an existing guardrail or median barrier at the site, the backup of the QuadGuard System should tie into it when possible.

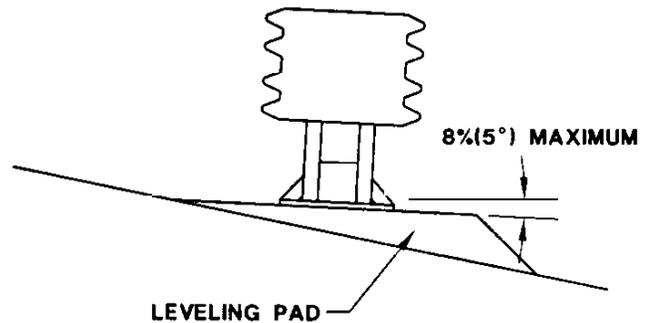


Figure 4: Slope

8. Is the system in a two-way traffic situation, with traffic going in opposite directions on either side of the system? If so, a Transition from the back of the system to the hazard is necessary to prevent vehicle snagging. The gap between the Transition and the last Fender Panel must be a maximum of 20mm [.78in]. In these cases the centerline of the QuadGuard System must be parallel to the centerline of the median behind the system to within plus or minus 1° degree.
9. What type of backup is preferred? Refer to backup information in this manual. Backups are required but must be ordered separately.
10. Are there any other unique features at the site that may affect positioning or performance of the QuadGuard System?
11. System must be anchored. MP-3® polyester anchor bolts will be supplied for all required anchorages in concrete. Refer to QuadGuard Installation Manual, MP-3 product information brochure or MP-3 kits for detailed installation instructions.

The QuadGuard™ System

Design Criteria

QuadGuard Standard Unit Model Numbers

Table B: Model Numbers

Number of Bays	Nominal Width		
	610mm [24in]	760mm [30in]	915mm [36in]
1	QS2401G	QS3001G	QS3601G
2	QS2402G	QS3002G	QS3602G
3	QS2403G	QS3003G	QS3603G
4	QS2404G	QS3004G	QS3604G
5	QS2405G	QS3005G	QS3605G
6	QS2406G	QS3006G	QS3606G
7	QS2407G	QS3007G	QS3607G
8	QS2408G	QS3008G	QS3608G
9	QS2409G	QS3009G	QS3609G
10	QS24010G	QS30010G	QS36010G
11	QS24011G	QS30011G	QS36011G
12	QS24012G	QS30012G	QS36012G

Model Number Description

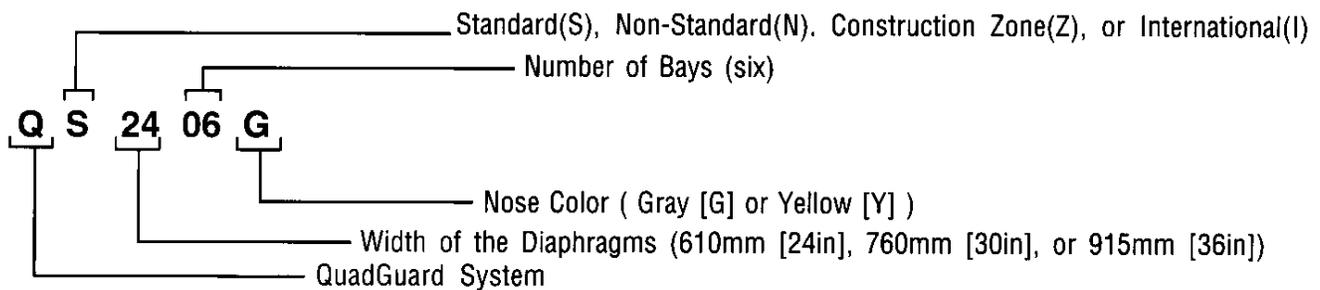
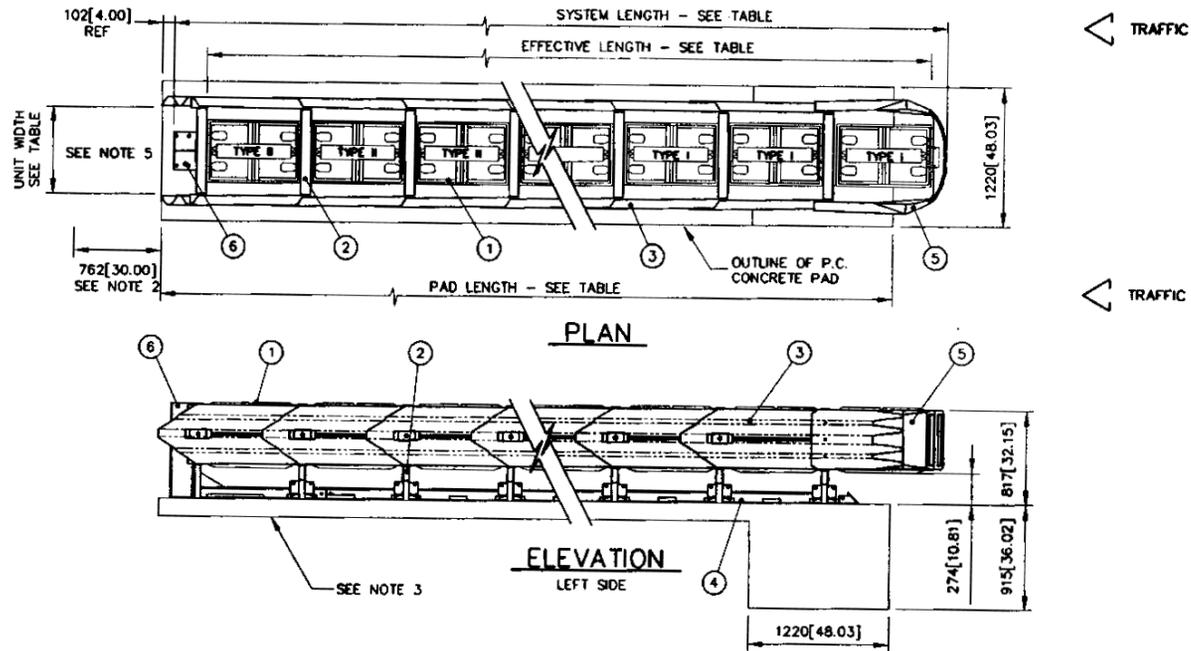


Figure 5: Model Number Key



*NOTE: BACKUP ASSEMBLY NOT INCLUDED IN MODEL NUMBER

BAYS	24" MODEL#		30" MODEL#		36" MODEL#		UNIT LENGTH		EFFECTIVE LENGTH		PAD LENGTH	
	GREY	YELLOW	GREY	YELLOW	GREY	YELLOW	m	ft-in	m	ft-in	m	ft-in
1	QS2401G	QS2401Y	QS3001G	QS3001Y	QS3601G	QS3601Y	2.16	7'-1"	1.74	5'-8"	2.74	9'-0"
2	QS2402G	QS2402Y	QS3002G	QS3002Y	QS3602G	QS3602Y	3.08	10'-1"	2.66	8'-8"	2.74	9'-0"
3	QS2403G	QS2403Y	QS3003G	QS3003Y	QS3603G	QS3603Y	4.00	13'-1"	3.57	11'-8"	3.66	12'-0"
4	QS2404G	QS2404Y	QS3004G	QS3004Y	QS3604G	QS3604Y	4.91	16'-1"	4.49	14'-8"	4.57	15'-0"
5	QS2405G	QS2405Y	QS3005G	QS3005Y	QS3605G	QS3605Y	5.83	19'-1"	5.40	17'-8"	5.49	18'-0"
6	QS2406G	QS2406Y	QS3006G	QS3006Y	QS3606G	QS3606Y	6.74	22'-1"	6.32	20'-8"	6.40	21'-0"
7	QS2407G	QS2407Y	QS3007G	QS3007Y	QS3607G	QS3607Y	7.65	25'-1"	7.23	23'-8"	7.32	24'-0"
8	QS2408G	QS2408Y	QS3008G	QS3008Y	QS3608G	QS3608Y	8.57	28'-1"	8.15	26'-8"	8.23	27'-0"
9	QS2409G	QS2409Y	QS3009G	QS3009Y	QS3609G	QS3609Y	9.49	31'-1"	9.06	29'-8"	9.14	30'-0"
10	QS2410G	QS2410Y	QS3010G	QS3010Y	QS3610G	QS3610Y	10.40	34'-1"	9.98	32'-8"	10.06	33'-0"
11	QS2411G	QS2411Y	QS3011G	QS3011Y	QS3611G	QS3611Y	11.32	37'-1"	10.89	35'-8"	10.97	36'-0"
12	QS2412G	QS2412Y	QS3012G	QS3012Y	QS3612G	QS3612Y	12.23	40'-1"	11.81	38'-8"	11.89	39'-0"

NOTES:

- IN COMPLIANCE WITH THE AASHTO 1996 ROADSIDE DESIGN GUIDE, MANUFACTURER RECOMMENDS REMOVAL OF ALL CURBS AND ISLANDS TO ENSURE PROPER IMPACT PERFORMANCE.
- PROVISION SHALL BE MADE FOR REAR FENDER PANELS TO SLIDE REARWARD UPON IMPACT 762 [30.00] MIN.
- 152 [6.00] MIN. REINFORCED 27.8 MPa [4000 PSI] P.C. CONCRETE PAD OR 203 [8.00] MIN. NON-REINFORCED 27.6 MPa [4000 PSI] P.C. CONCRETE ROADWAY.
- SEE THE "QUADGUARD SYSTEM DESIGN MANUAL" CODED DR 826-708 FOR A DESCRIPTION OF ITS IMPACT PERFORMANCE CHARACTERISTICS AND DESIGN LIMITATIONS BEFORE PLACING A SYSTEM AT A GIVEN SITE. INFORMATION AND COPIES OF ABOVE MANUAL ARE AVAILABLE BY CALLING CUSTOMER SERVICE DEPARTMENT AT (312) 467-6750.
- WHERE NECESSARY, THE CUSTOMER SHALL SUPPLY A TRANSITION FROM THE QUADGUARD SYSTEM TO THE OBJECT BEING SHIELDED.
- UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.

KEY	①	QUADGUARD CARTRIDGE	④	MONORAIL
	②	DIAPHRAGM	⑤	NOSE ASSEMBLY
	③	FENDER PANEL	⑥	TENSION STRUT BACKUP

REFERENCES	
CONCRETE PAD	35-40-11
DIAPHRAGM ASSEMBLY	35-40-07
NOSE ASSEMBLY	35-40-05
FENDER PANEL ASSEMBLY	35-40-04
TENSION STRUT ASSEMBLY	35-40-03
RAIL ASSEMBLY	35-40-06

DATE	3/21/96
DESIGNED BY	S. LEWIS
DATE	3/1/96
DESIGNED BY	JVM/MHO
DATE	
APPROVED BY	
DATE	
CAD FILE	QSTSCVR-U.dwg
NEXT ASSEMBLY	

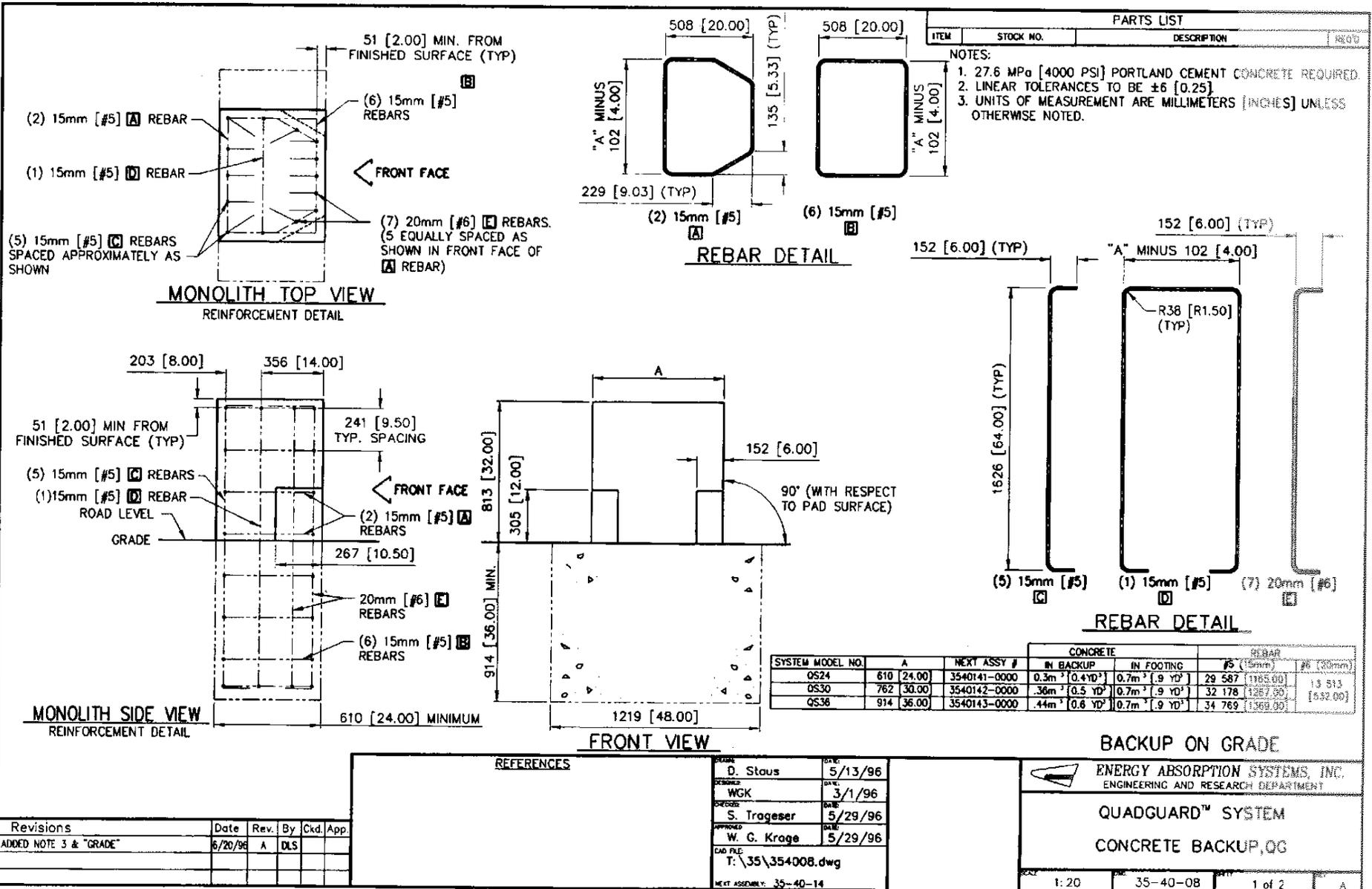
UNIDIRECTIONAL



ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

QUADGUARD™ SYSTEM
W/ TENSION STRUT BACKUP

SCALE: 1=40 NO: QSTSCVR-U SHEET: 1 of 1 REV:



PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	REQD

- NOTES:
- 27.6 MPa [4000 PSI] PORTLAND CEMENT CONCRETE REQUIRED.
 - LINEAR TOLERANCES TO BE ±6 [0.25]
 - UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.

SYSTEM MODEL NO.	A	NEXT ASSY #	CONCRETE		REBAR	
			IN BACKUP	IN FOOTING	#5 (15mm)	#6 (20mm)
QS24	610 [24.00]	3540141-0000	0.3m ³ [0.4 YD ³]	0.7m ³ [0.9 YD ³]	29 587 [1185.00]	13 513 [532.00]
QS30	762 [30.00]	3540142-0000	.36m ³ [0.5 YD ³]	0.7m ³ [0.9 YD ³]	32 178 [1267.90]	
QS36	914 [36.00]	3540143-0000	.44m ³ [0.6 YD ³]	0.7m ³ [0.9 YD ³]	34 769 [1369.00]	

Revisions	Date	Rev.	By	Ckd.	App.
ADDED NOTE 3 & "GRADE"	6/20/96	A	DLS		

REFERENCES

DESIGNED BY	D. Staus	DATE	5/13/96
CHECKED BY	W.G.K.	DATE	3/1/96
APPROVED BY	S. Trageser	DATE	5/29/96
DATE	W. G. Krage	DATE	5/29/96
DWG FILE	T:\35\354008.dwg		
NEXT ASSEMBLY	35-40-14		

BACKUP ON GRADE

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

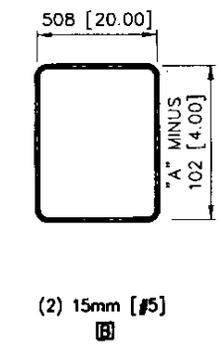
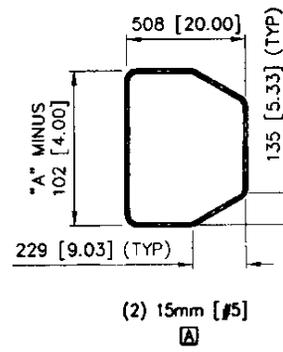
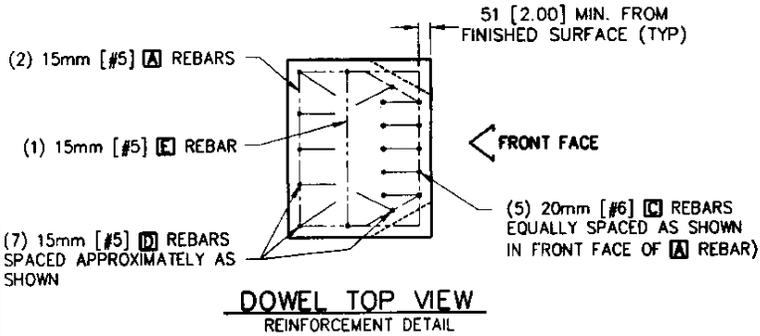
QUADGUARD™ SYSTEM

CONCRETE BACKUP, 06

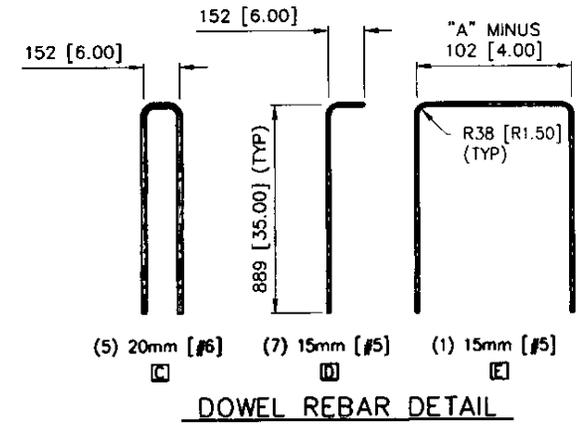
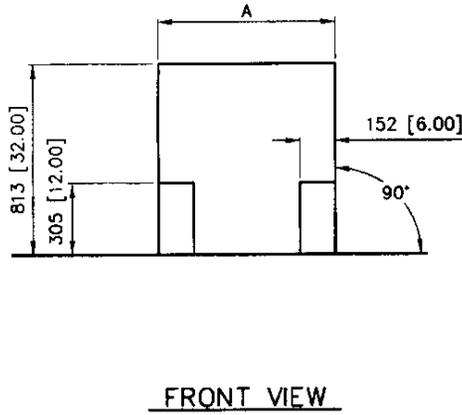
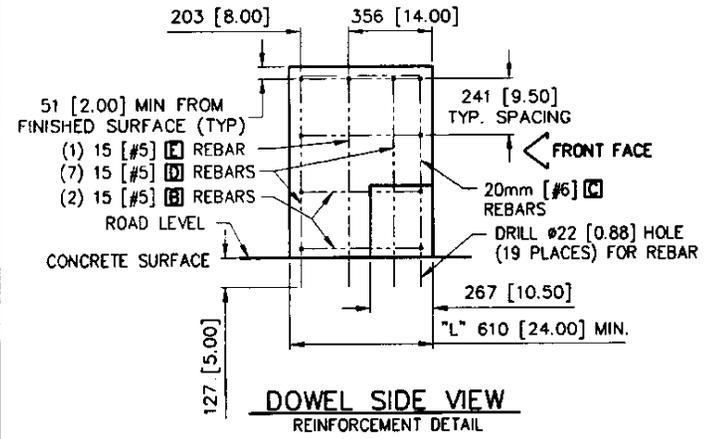
SCALE	1:20	PROJECT	35-40-08	SHEET	1 of 2	DATE	A
-------	------	---------	----------	-------	--------	------	---

SYSTEM MODEL NO.	A		NEXT ASSY #	CONCRETE		REBAR	
	QTY	UNIT PRICE		QTY	UNIT PRICE	QTY	UNIT PRICE
Q524	610	24.00	3540141-0000	0.3m ³	(0.4YD ³)	17 318	682.00
Q530	762	30.00	3540142-0000	.36m ²	(0.5 YD ²)	18 690	736.00
Q536	914	36.00	3540143-0000	.44m ²	(0.6 YD ²)	20 063	790.00

PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	REQ'D



REBAR DETAIL



- NOTE: #6 MPa [4000 PSI] PORTLAND CEMENT CONCRETE REQUIRED.
 2. LINEAR TOLERANCES TO BE ±6 [0.25].
 3. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.

BACKUP ON DECK

Revisions	Date	Rev.	By	Ckd.	App.
ADDED NOTE 3 & "CONCRETE SURFACE"	5/20/96	A	DLS		

REFERENCES	

DESIGNED	D. Staus	DATE	5/13/96
DRAWN	W.G.K.	DATE	3/1/96
CHECKED	S. Trageser	DATE	5/29/96
APPROVED	W. G. Krage	DATE	5/29/96
CAD FILE:	T:\35\354008-02.dwg		
NEXT ASSEMBLY:	35-40-14		

ENERGY ABSORPTION SYSTEMS, INC.
 ENGINEERING AND RESEARCH DEPARTMENT

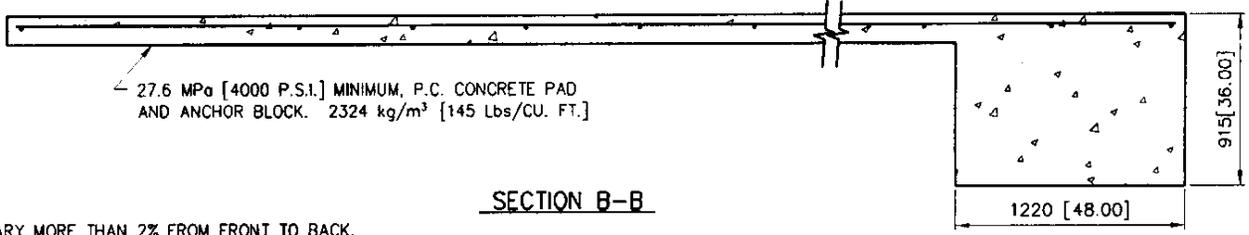
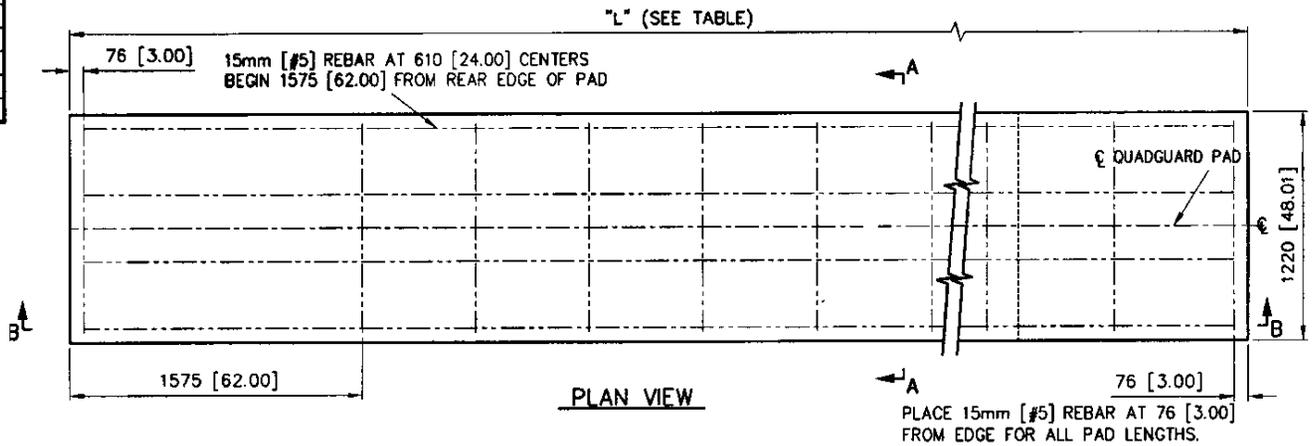
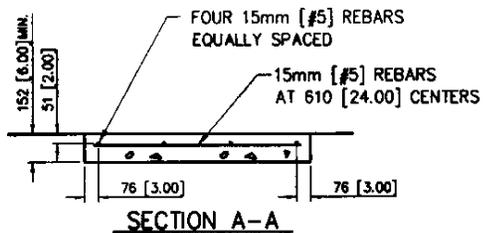
QUADGUARD™ SYSTEM

CONCRETE BACKUP, QG

SCALE: 1:20 35-40-08 2 of 2 A

NO. OF BAYS	TABLE				YARDS OF CONCRETE IN PAD m ³ [YARDS ³]	
	"L" (PAD LENGTH)		REBAR REQUIRED			
	[m]	[ft-in]	[m]	[ft-in]		
1	2.74	[9'-0"]	14.83	[48'-8"]	1.59	[2.1]
2	2.74	[9'-0"]	14.83	[48'-8"]	1.59	[2.1]
3	3.66	[12'-0"]	20.73	[68'-0"]	1.82	[2.4]
4	4.57	[15'-0"]	25.50	[83'-8"]	1.97	[2.6]
5	5.49	[18'-0"]	31.39	[103'-0"]	2.12	[2.8]
6	6.40	[21'-0"]	36.17	[118'-8"]	2.35	[3.1]
7	7.32	[24'-0"]	42.06	[138'-0"]	2.51	[3.3]
8	8.23	[27'-0"]	46.84	[153'-8"]	2.66	[3.5]
9	9.14	[30'-0"]	52.73	[173'-0"]	2.81	[3.7]
10	10.06	[33'-0"]	57.51	[188'-8"]	3.04	[4.0]
11	10.97	[36'-0"]	63.40	[208'-0"]	3.19	[4.2]
12	11.89	[39'-0"]	68.17	[223'-8"]	3.35	[4.4]

PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	REQ'D



- NOTES:
- CROSS SLOPE OF PAD SHALL NOT EXCEED 8%, AND NOT VARY MORE THAN 2% FROM FRONT TO BACK.
 - UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.

REFERENCES

DESIGNER	D. Staus	DATE	5/15/96
DESIGNED	W.G.K.	DATE	3/1/96
CHECKED	S. Trageser	DATE	5/20/96
APPROVED	W. G. Krage	DATE	5/20/96
CAD FILE	T:\35\354011.DWG		
NEXT ASSEMBLY			

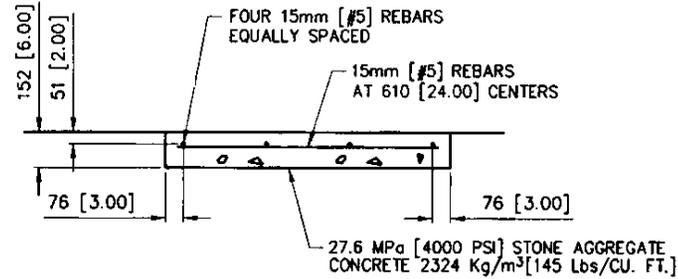
ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

QUADGUARD™ SYSTEM
CONCRETE PAD, TENSION STRUT, QG

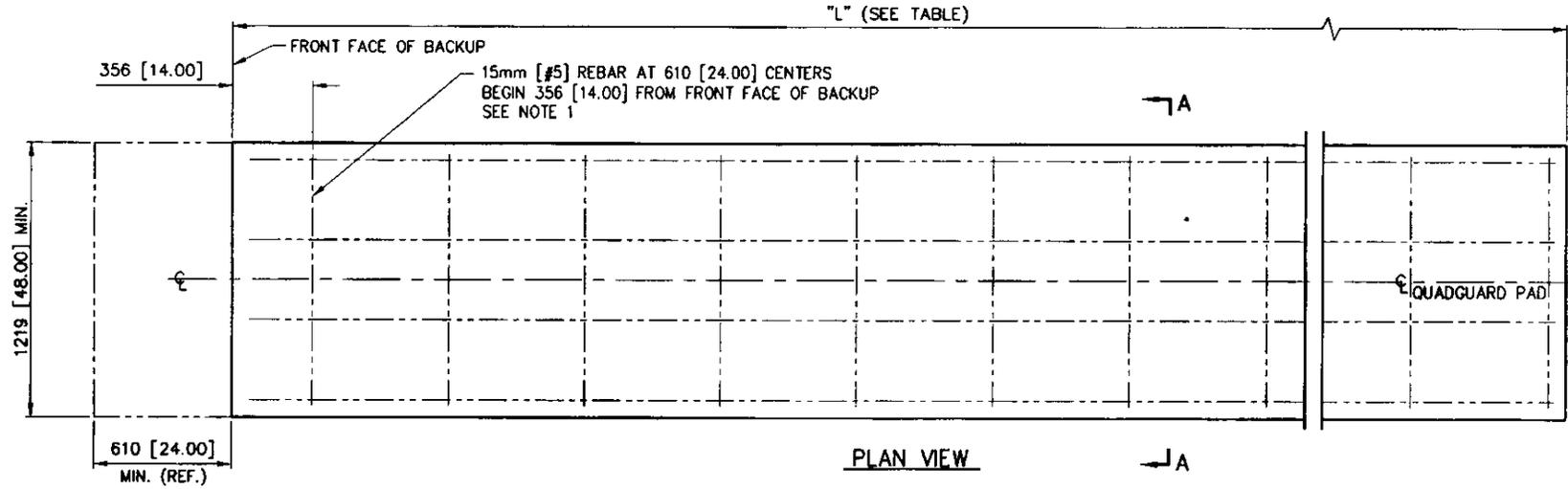
SCALE: 1:25 DWG: 35-40-11 SHEET: 1 of 1 REV: A

Revisions	Date	Rev.	By	Ckd.	App.
ADDED NOTE 2, CHGO TITLE	5/20/96	A	DLS		

TABLE "L"			
NO. OF BAYS	"L" (PAD LENGTH)		YARDS OF CONCRETE IN PAD (YARDS ³)
		REBAR REQUIRED	
1	1.68 [5'-6"]	9.55 [31'-4"]	0.37 [0.5]
2	2.59 [8'-6"]	15.44 [50'-8"]	0.52 [0.7]
3	3.51 [11'-6"]	20.22 [66'-4"]	0.66 [0.9]
4	4.42 [14'-6"]	26.11 [85'-8"]	0.83 [1.1]
5	5.33 [17'-6"]	30.89 [101'-4"]	1.05 [1.4]
6	6.25 [20'-6"]	36.78 [120'-8"]	1.21 [1.6]
7	7.16 [23'-6"]	41.55 [136'-4"]	1.36 [1.8]
8	8.08 [26'-6"]	47.45 [155'-8"]	1.51 [2.0]
9	8.99 [29'-6"]	52.22 [171'-4"]	1.74 [2.3]
10	9.91 [32'-6"]	58.12 [190'-8"]	1.89 [2.5]
11	10.82 [35'-6"]	62.89 [206'-4"]	2.04 [2.7]
12	11.74 [38'-6"]	68.78 [225'-8"]	2.20 [2.9]



SECTION A-A



PLAN VIEW

NOTES:
 1. CROSS SLOPE OF PAD SHALL NOT EXCEED 8%, AND NOT VARY MORE THAN 2% FROM FRONT TO BACK.

REFERENCES

DESIGNED BY D. Stous	DATE 5/15/96
REVISIONS WCK	DATE 3/1/96
CHECKED BY S. Trageser	DATE 5/24/96
APPROVED BY WCK	DATE 3/1/96
CAD FILE: T:\35\354009.dwg	
NEXT ASSEMBLY:	

 ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT	QUADGUARD™ SYSTEM	
	CONCRETE PAD, FOR CONC. BACKUP, QC	
SCALE: 1:20	FIG: 35-40-09	SHEET: 1 of 1



QUADGUARD CZ

B4

Contains:

QUADGUARD CZ Photos

QUADGUARD CZ Design Criteria

QUADGUARD CZ Plan Sheets

QUADGUARD CZ Foundation Specifications

QUADGUARD CZ Limitations & Warnings

QuadGuard™ CZ



Built-in lifting brackets allow the system to be moved as a complete unit.

NCHRP 350, TL-3 Performance In A Portable Crash Cushion For Work Zones

The QuadGuard CZ is an innovative, new crash cushion for work zones. It consists of crushable, energy-absorbing cartridges surrounded by a framework of Energy's exclusive steel Quad-Beam™ panels. The QuadGuard CZ meets all of today's strict crash cushion performance requirements as mandated by NCHRP 350, Test Level 3, and provides the same lifesaving efficiency and features of the permanent QuadGuard System, in a compact, portable unit.

- Redirective and non-gating
- Compact, modular design (3 to 9 bays) accommodates speeds from 70 km/h (45 mph) to 115 km/h (71 mph).
- Quad-Beam panels provide 30% higher beam strength than three beam.
- "Staged" cartridge design safely decelerates both light cars and heavier, high center-of-gravity vehicles.
- Monorail base eliminates the need for anchoring chains and tension cable meaning easy installation.
- Self-supporting nose – no legs.
- High 80% reusability after most design impacts.
- Lifting brackets allow easy repositioning as a complete unit.



The QuadGuard CZ System has successfully passed the complete test matrix for NCHRP 350, Test Level 3.

Meets NCHRP 350, Test Level 3

The QuadGuard CZ System has successfully passed the complete NCHRP 350, Test Level 3 test matrix for redirective, non-gating attenuators with both the light car and high center-of-gravity pickup truck at speeds up to 100 km/h (62 mph) at angles up to 20°. For higher speed units, contact Energy Absorption Systems.

During head-on impacts, the QuadGuard CZ System telescopes rearward and crushes to absorb the energy of impact. When impacted from the side, the system safely redirects the errant vehicle back toward its original travel path, with no gating.



**ENERGY ABSORPTION
SYSTEMS, INC.**

Saving Lives by Design



QuadGuard™ cz Design Criteria

The portable crash cushion for construction zones.

The QuadGuard cz is available in the following nominal sizes:

LENGTH	WIDTH
3.58m [11ft 9in] (3 Bay)	610mm [2ft]
3.58m [11ft 9in] (3 Bay)	760mm [2ft 6in]
6.33m [20ft 9in] (6 Bay)	610mm [2ft]
6.33m [20ft 9in] (6 Bay)	760mm [2ft 6in]

A wise choice...

because the Construction Zone QuadGuard (QuadGuard cz) provides the same lifesaving efficiency and features of the permanent QuadGuard System in a compact, portable design. The QuadGuard cz is designed to redirect vehicles hitting the system along the side. After a typical design speed head on impact the majority of the system can be used again. The system can usually be repaired by pulling it back into place and replacing the Nose and Cartridges. (Depending on the foundation a QuadGuard cz may need to be reset after impact.)

because the QuadGuard cz is easy to transport.

The system can be pre-assembled away from the job site. When the need arises, the QuadGuard cz, can be positioned at the impact site with the aid of a 2 ton lifting device.

because installation of the QuadGuard cz usually requires little site preparation. Both the lifting platform and steel backup are integral parts of the QuadGuard cz so the installation of anchor bolts is usually all that is necessary.

A wise choice...

because the QuadGuard cz may be permanently installed on a prepared site. When there is no longer a need for temporary site protection, or when the construction job is finished, the QuadGuard cz can be installed to function with the same capabilities as a conventional QuadGuard System.

because the QuadGuard cz is safety efficient. Cartridges offer exceptional energy absorbing efficiency. Because the system that meets your design criteria will be shorter and will occupy fewer square feet of surface, the QuadGuard cz System offers the best size/efficiency ratio of any impact attenuator. This increases driver decision distance and reduces the likelihood of the system being hit.

because the QuadGuard cz meets your needs for temporary protection at most construction sites.

Whether it be the end of unfinished median barriers, bridge piers, temporary or permanent safety walls, light posts, or numerous other types of hazards. As with the permanent QuadGuard System, the system size should be chosen such that the width and length are no larger than necessary.

The QuadGuard cz must be properly anchored. Refer to page 23 for the recommended anchorage for various foundations.



For Customer Service Call
1-888-32-ENERG

The QuadGuard™ System

QuadGuard™ cz Design Criteria

Table C: Design

NCHRP 350 Test Level	Design Velocity kph [mph]	Number of Bays	Effective Length m [ft]	Number of Cartridges	
				Type I Front of Svstem	Type II Rear of System
TL-2	70 [44]	3	3.57 [11.75]	2	2
TL-3	100 [62]	6	6.32 [20.75]	4	3

QuadGuard™ cz Unit Model Numbers

Table D: Model Numbers

Number of Bays	Nominal Width	
	610mm [24in]	760mm [30in]
3	QZ2403G	QZ3003G
6	QZ2406G	QZ3006G

Model Number Description

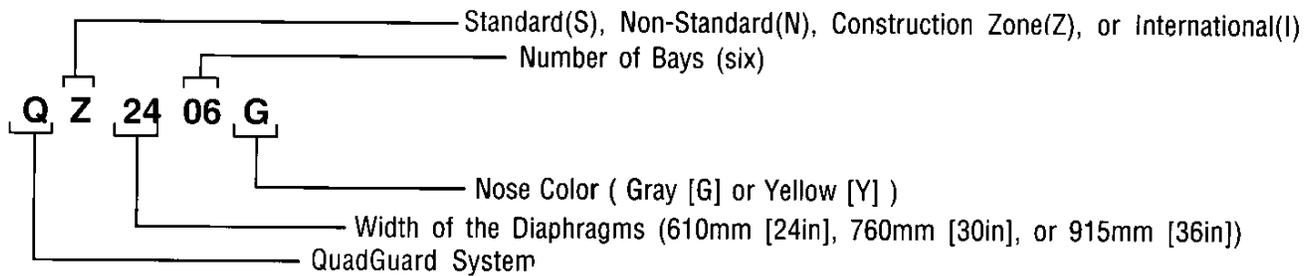
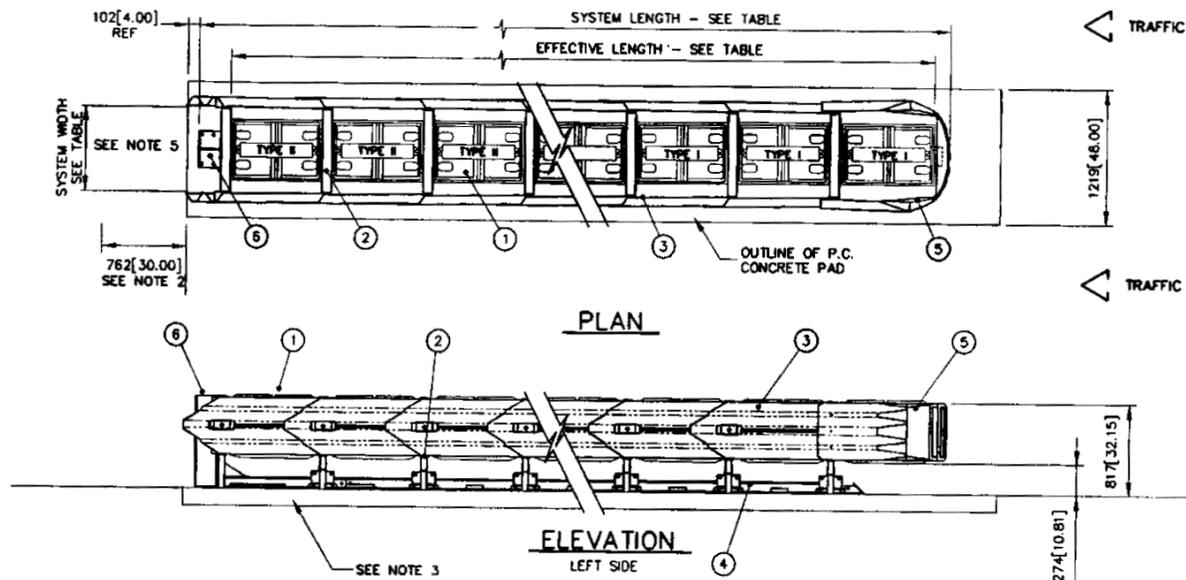


Figure 6: Model Number Key



- NOTES:
- IN COMPLIANCE WITH THE AASHTO 1996 ROADSIDE DESIGN GUIDE, MANUFACTURER RECOMMENDS REMOVAL OF ALL CURBS AND ISLANDS TO ENSURE PROPER IMPACT PERFORMANCE.
 - PROVISION SHALL BE MADE FOR REAR FENDER PANELS TO SLIDE REARWARD UPON IMPACT 762 [30.00] MIN.
 - CAUTION: THE QUADGUARD C.Z. MUST BE CORRECTLY ANCHORED FOR PROPER IMPACT PERFORMANCE.**
 ATTACH SYSTEM USING ONE OF THE FOLLOWING:
 - 7" STUDS MAY BE USED TO ATTACH SYSTEM TO 27.6 MPa[4000 PSI] MIN. P.C. CONCRETE PER THE FOLLOWING MINIMUMS:**
 a) 152[6.00] NON REINFORCED ROADWAY OR PAD
 b) 203[8.00] REINFORCED PORTABLE PAD PER THE REFERENCE DETAIL
 c) 178[7.00] DECK STRUCTURE
 - 18" THREADED RODS MAY BE USED TO INSTALL SYSTEM ON ASPHALT.**
 **REFER TO THE QUADGUARD C.Z. MP-3 ANCHORING SYSTEM INSTALLATION INSTRUCTIONS FOR SPECIFICATIONS.

4. SEE THE "QUADGUARD SYSTEM DESIGN MANUAL" CODED DRE 820-788 FOR A DESCRIPTION OF ITS IMPACT PERFORMANCE CHARACTERISTICS AND DESIGN LIMITATIONS BEFORE PLACING A SYSTEM AT A GIVEN SITE. INFORMATION AND COPIES OF ABOVE MANUAL ARE AVAILABLE BY CALLING CUSTOMER SERVICE DEPARTMENT AT (312) 467-6750

- WHERE NECESSARY, THE CUSTOMER SHALL SUPPLY A TRANSITION FROM THE QUADGUARD SYSTEM TO THE OBJECT BEING SHIELDED.
- UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.

BAYS	24" MODEL#		30" MODEL#		UNIT LENGTH		EFFECTIVE LENGTH		PAD LENGTH	
	GREY	YELLOW	GREY	YELLOW	m	ft-in	m	ft-in	m	ft-in
3	QZ2403G	QZ2403Y	QZ3003G	QZ3003Y	4.00	[13'-1"]	3.57	[11'-8"]	4.57	[15'-0"]
6	QZ2406G	QZ2406Y	QZ3006G	QZ3006Y	6.74	[22'-1"]	6.32	[20'-8"]	7.01	[23'-0"]

KEY	①	QUADGUARD CARTRIDGE	④	MONORAIL
	②	DIAPHRAGM	⑤	NOSE ASSEMBLY
	③	FENDER PANEL	⑥	C. Z. BACKUP

REFERENCES	
PORTABLE CONCRETE PAD	35-40-10
DIAPHRAGM ASSEMBLY	35-40-07
NOSE ASSEMBLY	35-40-05
FENDER PANEL ASSEMBLY	35-40-04
C.Z. BACKUP & RAIL ASSY	35-40-16

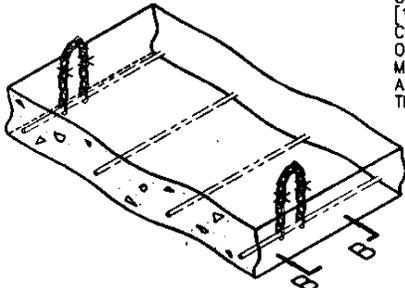
DESIGNED BY	S. TRAGESER	DATE	6/14/96
RECHECKED BY	JVM/MHO	DATE	3/1/96
ENGINEERED BY	KRM	DATE	6/17/96
APPROVED BY	J. Machado	DATE	6/17/96
CAD FILE	QSCZCVR-U.dwg		
NEXT ASSEMBLY			

UNIDIRECTIONAL

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

QUADGUARD™ c.z. SYSTEM
FOR CONSTRUCTION ZONES

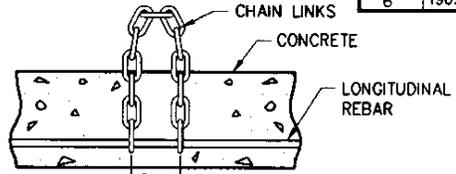
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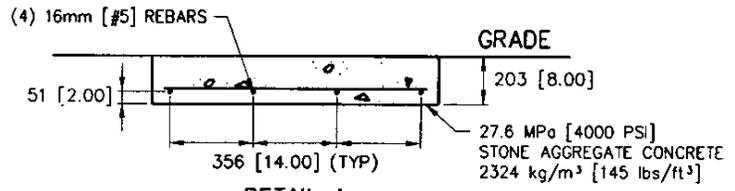
OPTIONAL LIFTING POINTS: USE 1/2" (13mm) PROOF COIL CHAIN. THE CHAIN MUST MEET THE REQUIREMENTS OF ASTM A-413 GRADE 28. THE MINIMUM LENGTH CHAIN IS 15 LINKS AND THE REBAR WILL BE INSERTED THROUGH BOTH ENDS AS SHOWN.

NO. OF BAYS	"P" (LIFTING POINT)		"L" (PAD LENGTH)		REBAR REQUIRED		YARDS OF CONCRETE IN PAD	
	[mm]	[ft-in]	[m]	[ft-in]	[m]	[ft-in]	m ³	[YARDS ³]
3	1105	[3'-7 1/2"]	4.57	[15'-0"]	25.71	[84'-4"]	1.16	[1.5]
6	1969	[6'-5 1/2"]	7.01	[23'-0"]	39.93	[131'-0"]	1.76	[2.3]

TABLE	
SYSTEM WIDTH	"A"
NARROW	610 [24.00]
MEDIUM	762 [30.00]



104 [4.11]

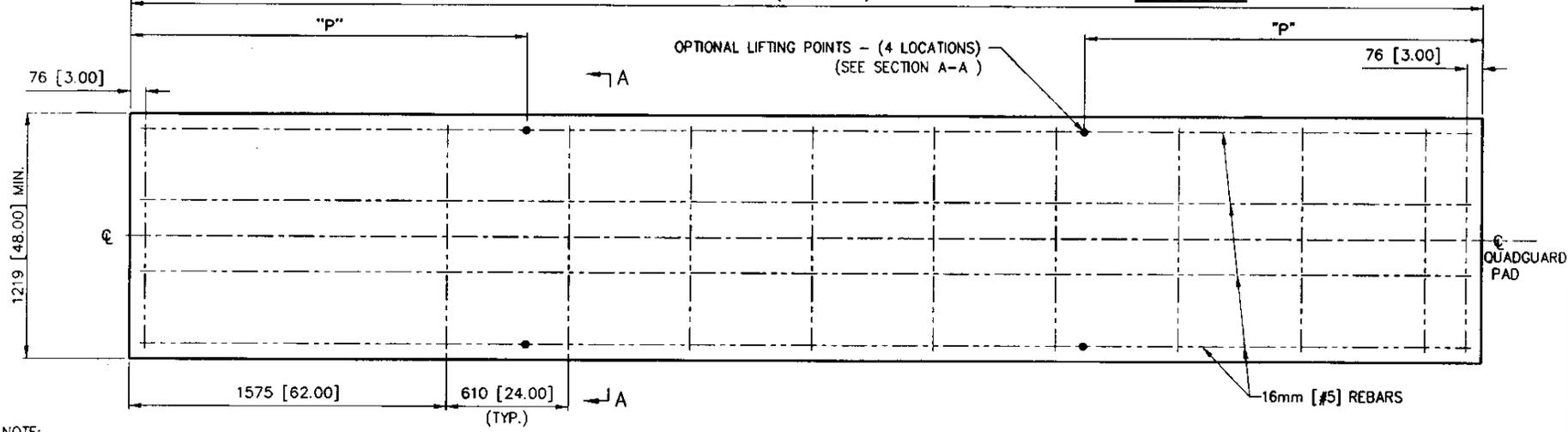


DETAIL A

SECTION A-A

SECTION B-B

"L" (SEE TABLE)



- NOTE:
- CROSS SLOPE OF PAD SHALL NOT EXCEED 8% AND NOT VARY MORE THAN 2% FROM FRONT TO BACK.
 - TO PREVENT SLIDING DURING AN IMPACT, PAD MUST BE INSTALLED AGAINST OR TIED TO AN EXISTING STRUCTURE. OTHERWISE ADDITIONAL BELOW GRADE SUPPORTS MUST BE ADDED AS DETERMINED NECESSARY BY THE PROJECT ENGINEER.
 - UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.

REFERENCES

DRWING	D. Staus	DATE	5/15/96
DESIGNED	WGK	DATE	3/1/96
CHECKED	S. Trageser	DATE	5/24/96
APPROVED	WGK	DATE	5/28/96
CAD FILE	T:\35\354010.dwg		
NEXT ASSEMBLY			

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

QUADGUARD™ SYSTEM
CONCRETE PAD, CZ, QG

SCALE: 1:20 PLOT: 35-40-10 SHEET: 1 of 1 REV: A

Revisions	Date	Rev.	By	Ckd.	App.
ADDED NOTE 3, REMOVED "WIDE" FROM TABLE	5/20/96	A	DLS		

QuadGuard cz Founda- tion Specifications

Foundation Specifications

The QuadGuard cz System may be installed on any of the following Foundations using the specified anchorage:

A: Concrete Pad

Foundation: 150mm [6in] minimum depth Portland Cement Concrete (P.C.C.)

Anchorage: MP-3® with 180mm [7in] studs
140mm [5.5in] embedment

B: Asphalt over P.C.C.

Foundation: 75mm [3 in] minimum Asphalt Concrete (A.C.) over 75mm [3in] minimum (P.C.C.)

Anchorage: MP-3 with 460mm [18in] studs
420mm [16.5in] embedment

C: Asphalt over Subbase

Foundation: 150mm [6in] minimum (A.C.) over 150mm [6in] minimum Compacted Subbase (C.S.)

Anchorage: MP-3 with 460mm [18in] studs
420mm [16.5in] embedment

D: Asphalt Only

Foundation: 200mm [8in] minimum (A.C.)

Anchorage: MP-3 with 460mm [18in] studs
420mm [16.5in] embedment

A. C. (Asphalt Concrete)

AR-4000 A. C.

(per ASTM D3381 '83) .75in Maximum,

Medium (Type A or B) aggregate

Sieve Size	Operating Range (%)	Passing
1"	100	
3/4"	95-100	
3/8"	65-80	
No. 4	49-54	
No. 8	36-40	
No. 30	18-21	
No. 200	3-8	

P.C.C. (Portland Cement Concrete)

Stone aggregate concrete mix

4000psi minimum compressive strength

(Sampling per ASTM C31-84

or ASTM C42-84a, testing per ASTM C39-84)

C.S. (Compacted Subbase)

150mm [6in] minimum depth 95% compaction

Class 2 aggregate

Sieve Size	Moving Average %	Passing
3"	100	
2 1/2"	90-100	
No. 4	40-90	
No. 200	0-25	



For Customer Service Call
1-888-32-ENERG

The QuadGuard™ System

Limitations And Warnings

The QuadGuard System has been tested and evaluated per the recommendations of the NCHRP 350 Guidelines* for Test Level 3 (TL-3) terminals and crash cushions. The impact conditions recommended in this guideline are intended to encompass the majority but not all, of the possible in-service collisions.

Properly installed and maintained, the QuadGuard System is capable of performing its function of stopping or containing and redirecting the test vehicles in a predictable and safe manner under the nominal NCHRP 350 TL-3 terminal and crash cushion impact conditions of:

Vehicles: Small car and pickup

Mass: 820 and 2000 kg [1808 and 4409 lb.]

Speed: 100 kph [62 mph]

Angle: 15° for small vehicle
20° for pickup

Impacts different than those described in NCHRP 350 for non-gating, redirecting crash cushions may result in different crash results than those encountered in testing. Furthermore, impacts in excess of TL-3 impact severity or the existence of curbs or cross slopes in excess of 8% may not result in acceptable crash performance as described in NCHRP 350 relative to structural adequacy, occupant risk and vehicle trajectory factors.

* Copy may be obtained from:

Transportation Research Board

National Research Council

2101 Constitution Avenue, N.W.

Washington, D.C. 20418



QUADTREND-350

B5

Information on QUADTREND-350

At the present time, information on Quadtrend-350 is not available.

We hope to have information in the near future.



ADIEM II

B6

Contains:

Internet Information

Intended Use

Placement Details

ADIEM II on Median or Shoulder

ADIEM II Erection Details

ADIEM II Base Repair Procedures

ADIEM II Module Repair Procedures

For general and the latest information on ADIEM II, please refer to www.trin.net.

The following is in addition to the information provided at the above website.

INTENDED USE

ADIEM (Advanced Dynamic Impact Extension Module) is a high-performance, redirecting, energy-absorbing crash cushion and end treatment for portable and permanent protection of concrete barriers, bridge parapet rail, bridge piers and other hazards. It is simply installed with pins on a smooth surface in the same plane as the barrier on soil, asphalt or concrete (ADIEM does not require any jobsite forming or pouring of a concrete pad).

For temporary or construction zone applications, the system may be easily relocated as the work zone changes, and from project to project.

The energy absorption elements of the ADIEM are lightly reinforced, ultra low strength perlite concrete modules. The ADIEM dissipates the energy of an impact as the light-weight modules are crushed. Clean up and restoration of the system into full service are quick and easy. Simply replace the damaged modules and minor sweep up of debris.

The redirection element of the system is a heavily reinforced concrete, variable height curb with automobile hub-height tube rails.

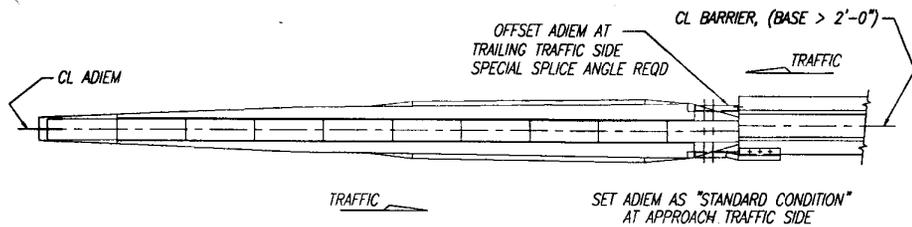
	<u>TL-3</u>	<u>TL-2</u>
Length -	9145 mm	5485 mm
Maximum width -	710 mm	710 mm
Height -	varies (sloped base)	
Design speed -	ALL NHS	75 km/h

CONTACT INFORMATION

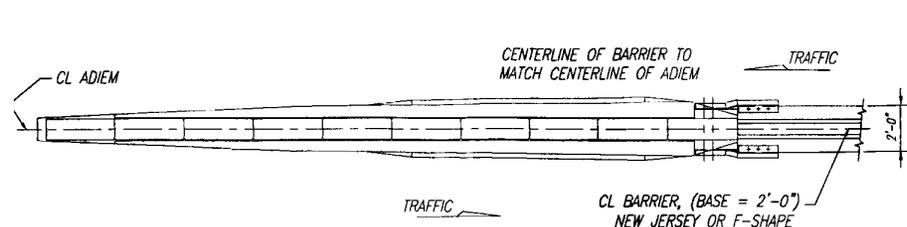
TRINITY/SYRO
Highway Safety Systems Division

Dallas, TX
(800) 644-7976

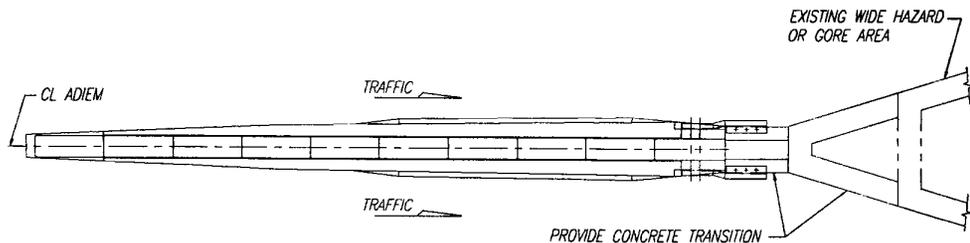
Girard, OH
(800) 321-2755



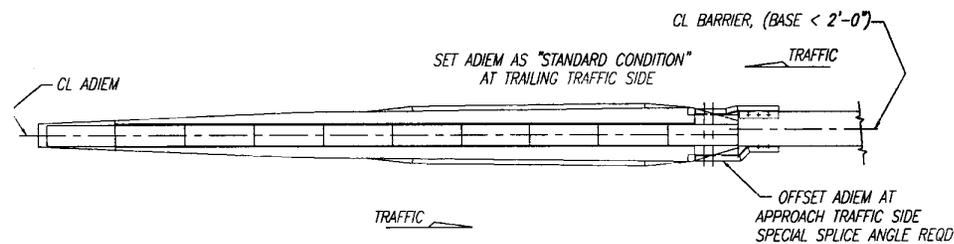
ADIEM PLACEMENT, WHEN BARRIER WIDTH > 2'-0"



"STANDARD CONDITION", WHEN BARRIER WIDTH = 2'-0"



ADIEM PLACEMENT, AT WIDE HAZARD OR GORE



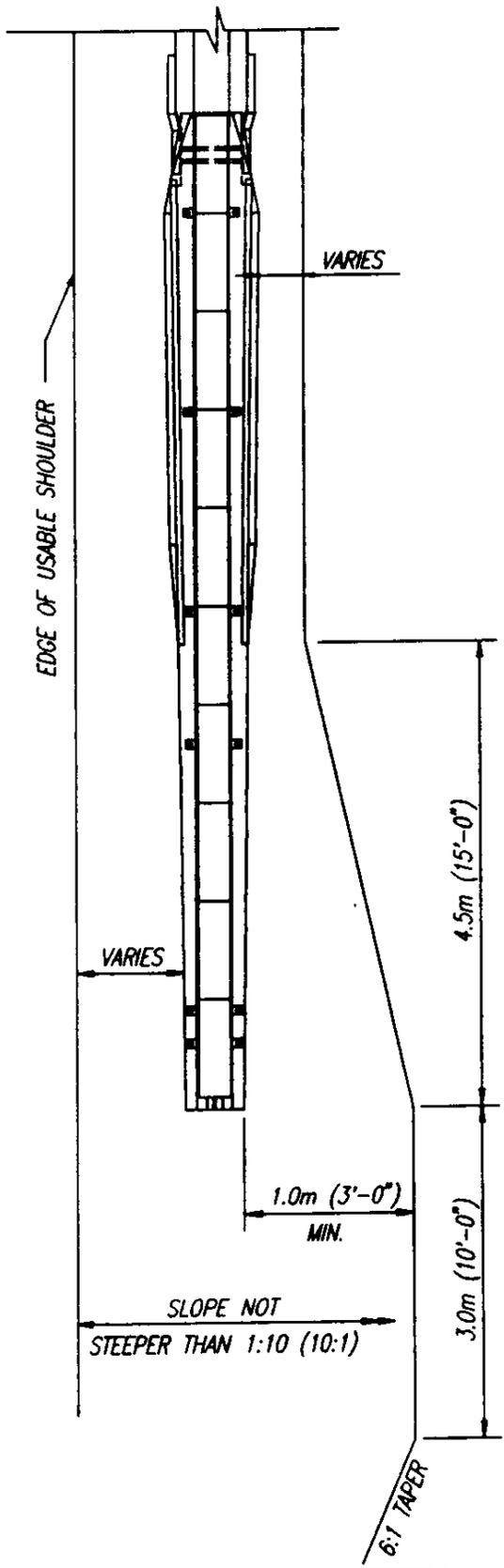
ADIEM PLACEMENT, WHEN BARRIER WIDTH < 2'-0"

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ADIEM II	
ADIEM II PLACEMENT DETAILS	
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CHECKED	
APPROVED	
DATE	10-28-97
ENG. FILE #	SS350
SHEET	ET OF 1
DRAWING NO.	SS 350
REV.	0

TRINITY INDUSTRIES, INC.
 DALLAS, TX GRAND, OH FORT WORTH, TX
 CENTERVILLE, UT LIMA, OH ELIZABETHTOWN, KY





NOTE: THE SLOPE BEYOND THE SHOULDER PAD SHOULD BE TO THE STATES STANDARDS OR THE SLOPE REQUIRED BY THE BENEFIT COST ANALYSIS IN THE "AASHTO ROADSIDE DESIGN GUIDE" FOR SLOPES.

MATERIAL:



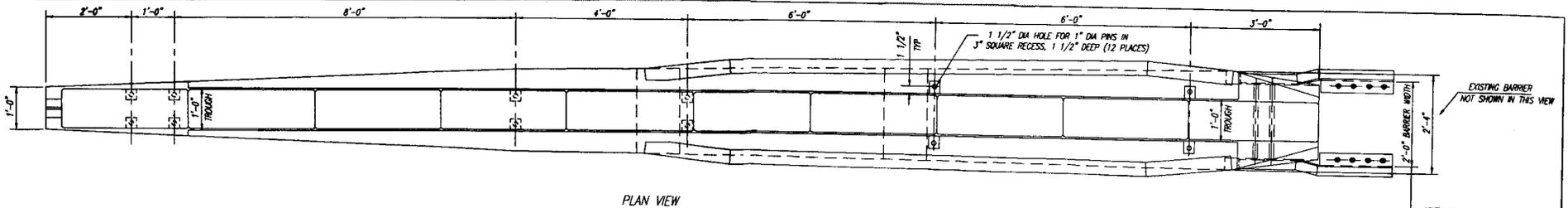
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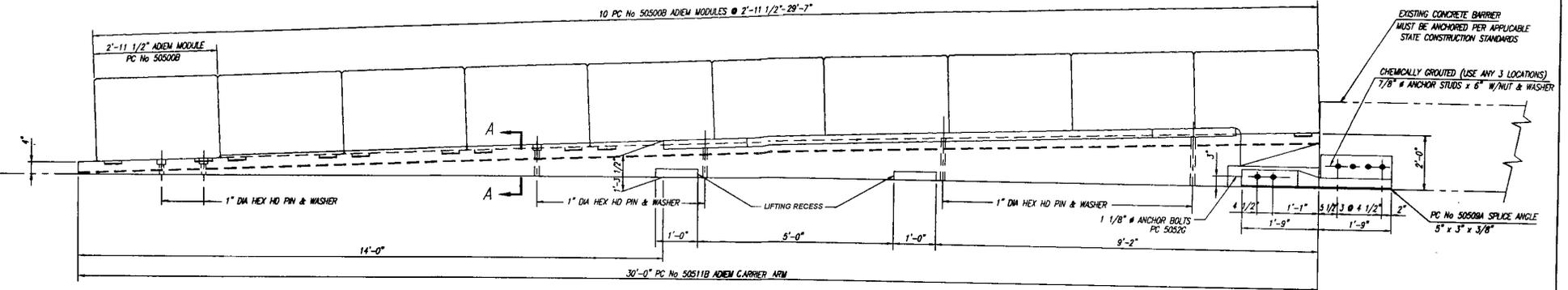
ADIEM ON MEDIAN OR SHOULDER

MK	BY	DATE	REVISION

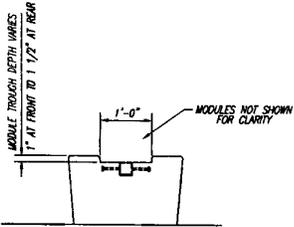
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DRAWING NO:			REV.
			SIZE A



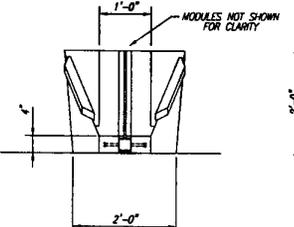
PLAN VIEW



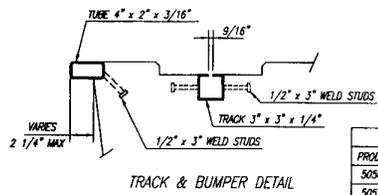
ELEVATION VIEW



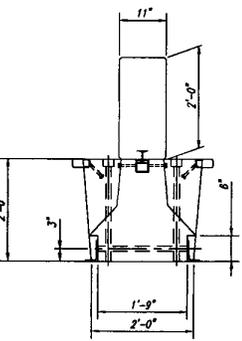
SECTION A-A



FRONT ELEVATION VIEW



TRACK & BUMPER DETAIL



REAR ELEVATION VIEW

BILL OF MATERIAL			
PRODUCT CODE	QTY	DESCRIPTION	REMARKS
50500B	10	MODULES x 2'-11 1/2"	
50511B	1	BASE x 30'-0"	
50508A	1	SPLICE ANGLE x 3'-6" RT	
50509A	1	SPLICE ANGLE x 3'-6" LT	
5906W	1	ACRYLINK COATING (1 GAL)	
5052C	2	1 1/8" # x 25" HEX HD BOLT	
4963C	4	1 1/8" WASHER	
3976C	2	1 1/8" HEX NUT	
4616C	6	7/8" STUD x 6" (FULL THD)	
3726C	6	7/8" WASHER	
3735C	6	7/8" HEX NUT	
4747C	1	CHEMICAL GROUT (1 QT)	
3900C	12	1" WASHER	

ANCHOR PIN SCHEDULE PER SURFACE (SEE NOTES 1-5)				
SEE	SEE	PCC	ACP	BASE
5665C	1" # HEX HD PIN x 48"			4
5642C	1" # HEX HD PIN x 42"		4	
5650C	1" # HEX HD PIN x 36"	4		4
5641C	1" # HEX HD PIN x 30"		4	4
5646C	1" # HEX HD PIN x 24"		4	4
5643C	1" # HEX HD PIN x 18"	4		

- ADIEM INSTALLATION INSTRUCTIONS**
- The ADIEM base is to be placed on a smooth surface (the same horizontal plane as the concrete barrier) and parallel to the mainline (or ramp traveled lane(s)).
 - Install anchor rods for ADIEM base by driving in soil or soft asphalt or driving in pre-drilled holes for hard asphalt or concrete (no epoxy required). The base should not be moved after the holes are drilled. The holes should be drilled using, at a minimum, a 3/8" hammer and minimum 3/8 inch long drill bit. (A 50# hammer is recommended.)
 - Attach connection brackets to base with two (2) 1 1/8" x 24" threaded rods provided. Then field drill holes into the existing barrier and attach the other end of the connection bracket to it with expansion anchor hardware provided.
 - Oil the ADIEM base track. Slide the modules onto the base. Be careful not to damage edges of the modules while sliding onto the base.
 - If the modules are scuffed or nicked, apply ACRYLINK coating to the affected area.
 - Recommended tools and equipment:
35/50# air hammer/drill
1 3/8" # x 36" rock drill
1 1/4" # x 12" rock drill
Sludge hammer
Or
Wrenches
 - Attach connection brackets to base with two (2) 1 1/8" x 25" hex head bolts provided. Then field drill holes in the existing barrier and attach connection brackets to it with chemically grouted hardware provided.

- ALTERNATE ADIEM INSTALLATION INSTRUCTIONS**
- At a holding site, the modules are slid into the ADIEM base after oiling the base track. Be careful not to damage the edges of the modules while sliding them onto the base.
 - If the modules are scuffed or nicked, apply ACRYLINK coating to the affected area.
 - The unit is then delivered to the job site. The unit is to be placed on a smooth surface (the same horizontal slope as the concrete barrier) and parallel to the mainline or ramp traveled lane (s).
 - The front module should be removed so the remaining modules can be shifted for easy access for drilling the anchor rod holes.
 - Install anchor rods for ADIEM base by driving in soil or soft asphalt or driving in predrilled holes for hard asphalt or concrete (no epoxy required). The base should not be moved after the holes are drilled. The holes should be drilled using, at a minimum, a 3/8" hammer and a minimum 3/8 inch long drilling bit. (A 50# hammer is recommended.)
 - Attach connection brackets to base with two (2) 1 1/8" x 25" hex head bolts provided. Then field drill holes in the existing barrier and attach connection brackets to it with chemically grouted hardware provided.

REV.	CHG'D BY	DATE	REMARKS
3	BT	3-14-97	DELETED PC 5484, ADDED PC 5052, CHG QTY PC3976
2	BT	2-14-97	GENERAL UPDATES
1	BT	1-29-97	GENERAL UPDATES

ADIEM II, 30'

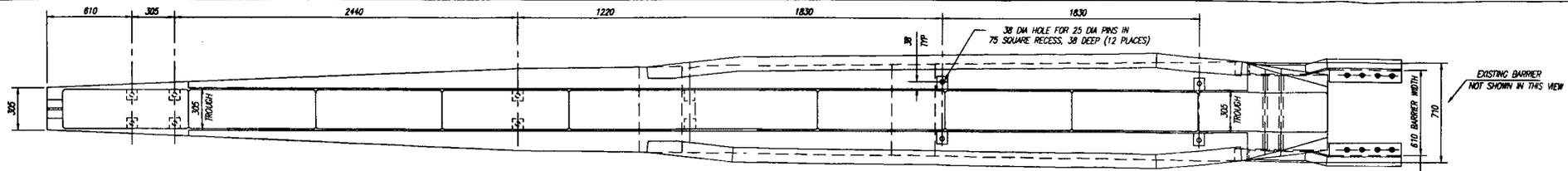
30' ADIEM II ERECTION DETAILS

CUSTOMER	P.O. No.	DRAWN	B. TAKACH
		CHECKED	
		APPROVED	
		DATE	3-19-96
		ENG. FILE #	SS349
		SHEET No.	ET OF 1
		DRAWING No.	SS 349
		REV.	3

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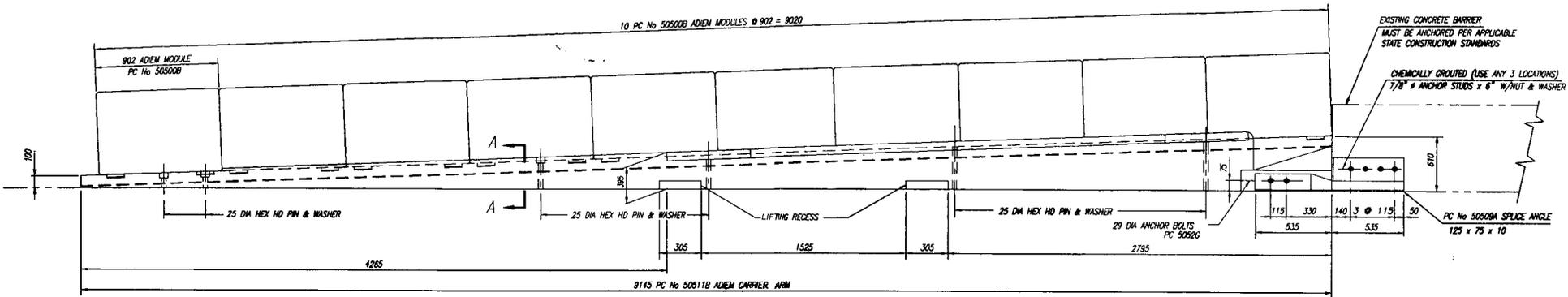
TRINITY INDUSTRIES, INC.

DALLAS, TX GRAND, OH FORT WORTH, TX
 CENTERVILLE, UT LIMA, OH ELIZABETHTOWN, KY



PLAN VIEW

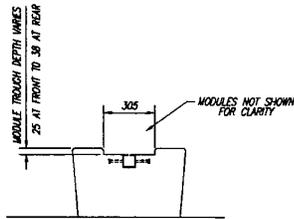
ADIEM II CAN BE USED WITH BARRIERS OF VARIOUS WIDTHS & CROSS-SECTIONS BY USE OF MODIFIED SPICE ANGLES.



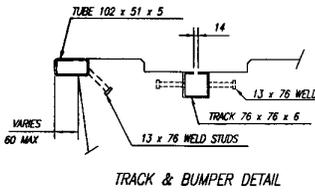
ELEVATION VIEW

EXISTING CONCRETE BARRIER MUST BE ANCHORED PER APPLICABLE STATE CONSTRUCTION STANDARDS.

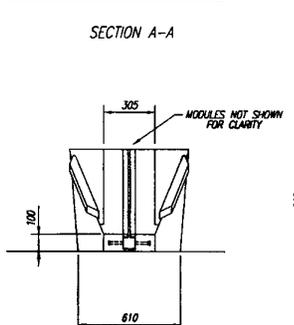
CHEMICALLY GROUTED (USE ANY 3 LOCATIONS) 7/8" # ANCHOR STUDS x 6" W/NUT & WASHER



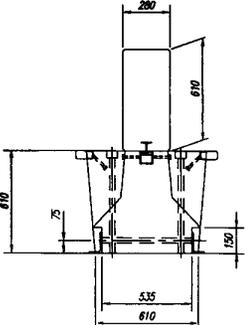
SECTION A-A



TRACK & BUMPER DETAIL



FRONT ELEVATION VIEW



REAR ELEVATION VIEW

BILL OF MATERIAL			
PRODUCT CODE	QTY	DESCRIPTION	REMARKS
505009	10	MODULES x 902	
50511B	1	BASE x 9145	
50508A	1	SPICE ANGLE x 1065 RT	
50509A	1	SPICE ANGLE x 1065 LT	
5906W	1	ACRYLINK COATING (3.8 LTR)	
5052C	2	29 # x 635 HEX HD BOLT	
4963C	4	29 WASHER	
3978C	2	29 HEX NUT	
4618C	6	22 # STUD x 150 (FULL TH)	
3725C	6	22 WASHER	
3735C	6	22 HEX NUT	
4747G	1	CHEMICAL GROUT (1 QT)	
3900C	12	25 WASHER	

ADIEM INSTALLATION INSTRUCTIONS

- The ADIEM base is to be placed on a smooth surface (the same horizontal plane as the concrete barrier) and parallel to the machine or ramp traveled lane(s).
- Install anchor rods for ADIEM base by driving in soil or soft asphalt or driving in pre-drilled holes for hard asphalt or concrete (no epoxy required). The base should not be moved after the holes are drilled. The holes should be drilled using, at a minimum, a 16 kg hammer and minimum 915 mm long drill bit. (A 23 kg hammer is recommended.)
- Attach connection brackets to base with two (2) 29 dia x 610 threaded rods provided. Then field drill holes into the existing barrier and attach the other end of the connection bracket to it with expansion anchor hardware provided.
- Oil the ADIEM base track. Slide the modules onto the base. Be careful not to damage edges of the modules while sliding onto the base.
- If the modules are scuffed or nicked, apply ACRYLINK coating to the affected area.
- Recommended tools and equipment:
16/23 kg air hammer/drill
35 dia x 915 rock drill
32 dia x 305 rock drill
Sledge hammer
Oil
Wrenches
- Attach connection brackets to base with two (2) 29 dia X 635 hex hd bolts provided. Then field drill holes in the existing barrier and attach connection brackets to it with chemically grouted hardware provided.

ALTERNATE ADIEM INSTALLATION INSTRUCTIONS

- At a holding site, the modules are slid into the ADIEM base after oiling the base track. Be careful not to damage the edges of the modules while sliding them onto the base.
- If the modules are scuffed or nicked, apply ACRYLINK coating to the affected area.
- The unit is then delivered to the job site. The unit is to be placed on a smooth surface (the same horizontal slope as the concrete barrier) and parallel to the machine or ramp traveled lane (s).
- The front module should be removed so the remaining modules can be shifted for easy access for drilling the anchor rod holes.
- Install anchor rods for ADIEM base by driving in soil or soft asphalt or driving in predrilled holes for hard asphalt or concrete (no epoxy required). The base should not be moved after the holes are drilled. The holes should be drilled using, at a minimum, a 16 kg hammer and a minimum 915 mm long drilling bit. (A 23 kg hammer is recommended.)
- Attach connection brackets to base with two (2) 29 dia X 635 hex head bolts provided. Then field drill holes in the existing barrier and attach connection brackets to it with chemically grouted anchor hardware provided.

ANCHOR PIN SCHEDULE PER SURFACE (SEE NOTES 1-5)

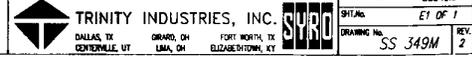
	PCC	ACP	BASE
5685C	25 # HEX HD PIN x 1220	4	4
5642C	25 # HEX HD PIN x 1065	4	4
5650C	25 # HEX HD PIN x 915	4	4
5641C	25 # HEX HD PIN x 760	4	4
5645C	25 # HEX HD PIN x 610	4	4
5643C	25 # HEX HD PIN x 455	4	4

NOTES:

- ANCHOR PINS ARE 25 DIA HEX HD, POINTED, GALV RODS (A307)
- PORTLAND CEMENT CONCRETE (PCC)
- ASPHALTIC CONCRETE (ACP)
- BASE AND/OR COMPACTED SOIL (BASE)
- ADIEM INSTALLATION NOT RECOMMENDED ON LOOSE SOIL.

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2	BT	3-14-97	DELETED PC 548A, ADDED PC 5052, CHG QTY PC 3976	
1	BT	2-14-97	GENERAL UPDATES	
REV	CHD	BY	DATE	REMARKS
ADIEM II, 9.1M				
9.1M ADIEM II ERECTION DETAILS				DRAWN: B. TAKACH CHECKED: APPROVED:
CUSTOMER				P.O. No.
DATE				1-29-97
ENG. FILE #				SS349M
DRAWING No.				SS 349M
REV.				2



ADIEM Base Repair Procedures

- Tools required: Normal concrete or masonry tools (trowels, brushes, forms, etc..) If needed specific tools can be listed, depending on severity of damage. A helpful hint: for most minor chips or damages try using Styrofoam forming which can be easily torn away after drying.
- Material required: Any standard highway concrete epoxy (10,000 psi or greater).
Dry cement (for aesthetics only, brand and strength not critical).
Clean cool water.
Sand
1. ADIEM base features: The ADIEM base unit has #6 reinforcing bars running longitudinally continuous from the front to the rear of the unit. The unit has #4 reinforcing bars running laterally placed every 6" on centers. The track in the center of the unit is made of 3/16" continuous material with 1/2" x 4" studs approximately every 6" on centers. There are redirecting bumpers on each side of the unit made of 3/16" material with 1/2" x 4" studs approximately every 6" on centers. The base is firmly held together with a concrete mixture of 4,500 psi or greater.
 2. ADIEM base utility: The ADIEM base serves the purpose of providing a secure holding line for the energy absorbing ADIEM modules. The unit is designed with the intent of having performance features based on specific angles and dimensions being held constant. In repairing the unit it is important to realize that **minor** chips and cracks, though aesthetically displeasing, should not affect the performance of the system. If the damage is greater than 2" deep or 6" long, a Syro technical representative should be contacted for assistance.
 3. ADIEM base repair: Use a brush to remove all loose material. Dampen area with sponge or cloth prior to application. If needed create a form to hold the mixture constant while drying occurs. Mix the highway concrete epoxy according to the directions given from the manufacturer. Apply mixture to damaged area and allow drying to occur per the manufacturers recommendations. Upon drying use a hammer or other rigid device to firmly strike the patched area, checking the area to be sure that proper bonding has occurred. After satisfactory testing is complete, mix the cement, sand, and water to create a "slurry," which can be applied with a brush and blend with existing concrete on the ADIEM base.

For additional information regarding repair procedures or obtaining materials please call:

Syro, Inc.
A Trinity Industries Company
2525 Stemmons Freeway
Dallas, Texas 75207
1/800-644-SYRO (7976)

ADIEM Module Repair Procedures

- Tools required: 4" to 6" putty knife (to spread repair mixture)
Small 1 to 2 gallon bucket or pan (to mix repair mixture)
3 to 5 gallon bucket (to mix the finish coat)
Paint Roller (to apply the finish coat)
- Material required: ADIEMcrete mixture
Perlite Granules
ADIEMcoat
Clean cool water
1. Surface preparation: Remove loose material.
Dampen area with sponge or cloth prior to application.
 2. ADIEMcrete mixture: Mix approximately 1 pound of "ADIEMcrete" with approximately 6 ounces of clean cool water.
Mix thoroughly until "ADIEMcrete" mixture reaches a stiff paste consistency.
 3. ADIEMcrete application: Using putty knife or similar tool pack the "ADIEMcrete" mixture the damaged area bringing the mixture to a smooth level finish with surrounding area. If the damage penetrates past the reinforcing cage or is no longer than six inches, a Syro technical representative should be contacted for assistance.
"ADIEMcrete" mixture will set in approximately 45 minutes.
 4. ADIEMcoat application: Insure that the "ADIEMcrete" mixture has set prior to applying the "ADIEMcoat" finish.
Mix the Perlite granular material with the liquid "ADIEMcoat" until a semi-stiff consistency is achieved.
Using a paint roller apply the "ADIEMcoat" finish to the repaired area applying additional coats as necessary to match the texture of the surrounding area.

For additional information regarding repair procedures or obtaining materials please call:

Syro, Inc.
A Trinity Industries Company
2525 Stemmons Freeway
Dallas, Texas 75207
1/800-644-SYRO (7976)



REACT 350

B7

Contains:

REACT 350 Photos

Explanation of REACT 350

REACT 350 Foundation Details

REACT 350 Inspections

REACT 350 Instructions for Repositioning

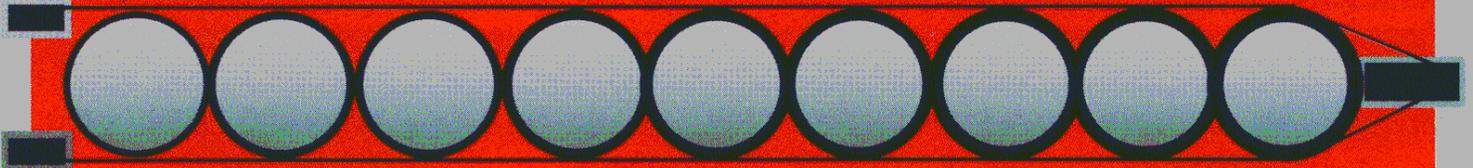
REACT 350 Instructions for Replacing Stabilizer Rods

ROADWAY SAFETY SERVICE, INC.

presents

REACT 350

Reusable Energy Absorbing Crash Terminal

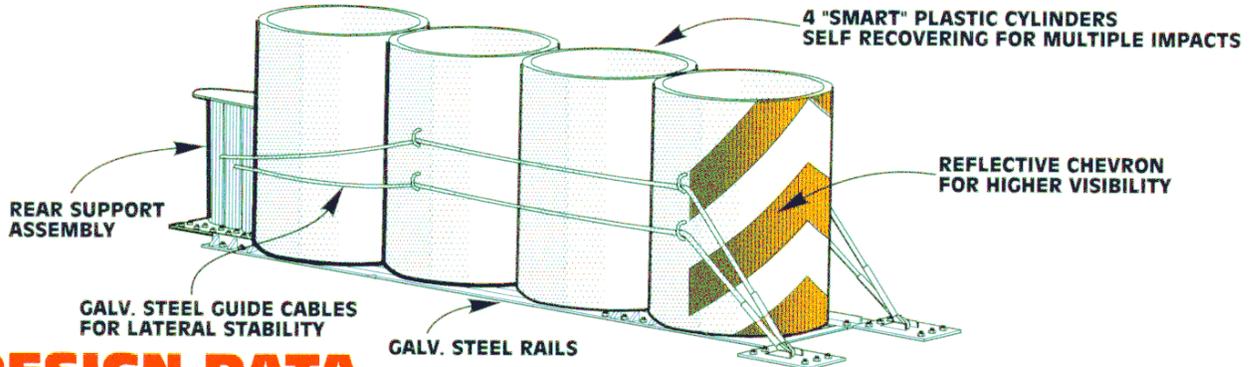


- ◆ **MULTIPLE HIT CAPABILITIES**
- ◆ **FULLY REUSABLE**
- ◆ **SELF RESTORING**
- ◆ **NCHRP 350 APPROVED**
- ◆ **SIMPLE INSTALLATION**
- ◆ **EXTREMELY COST EFFECTIVE**
- ◆ **FOR ALL SPEED IMPACTS**

80 REMINGTON BLVD, RONKONKOMA, NY 11779
516 / 588-6200 FAX 516 / 588-6394

REACT 350.4

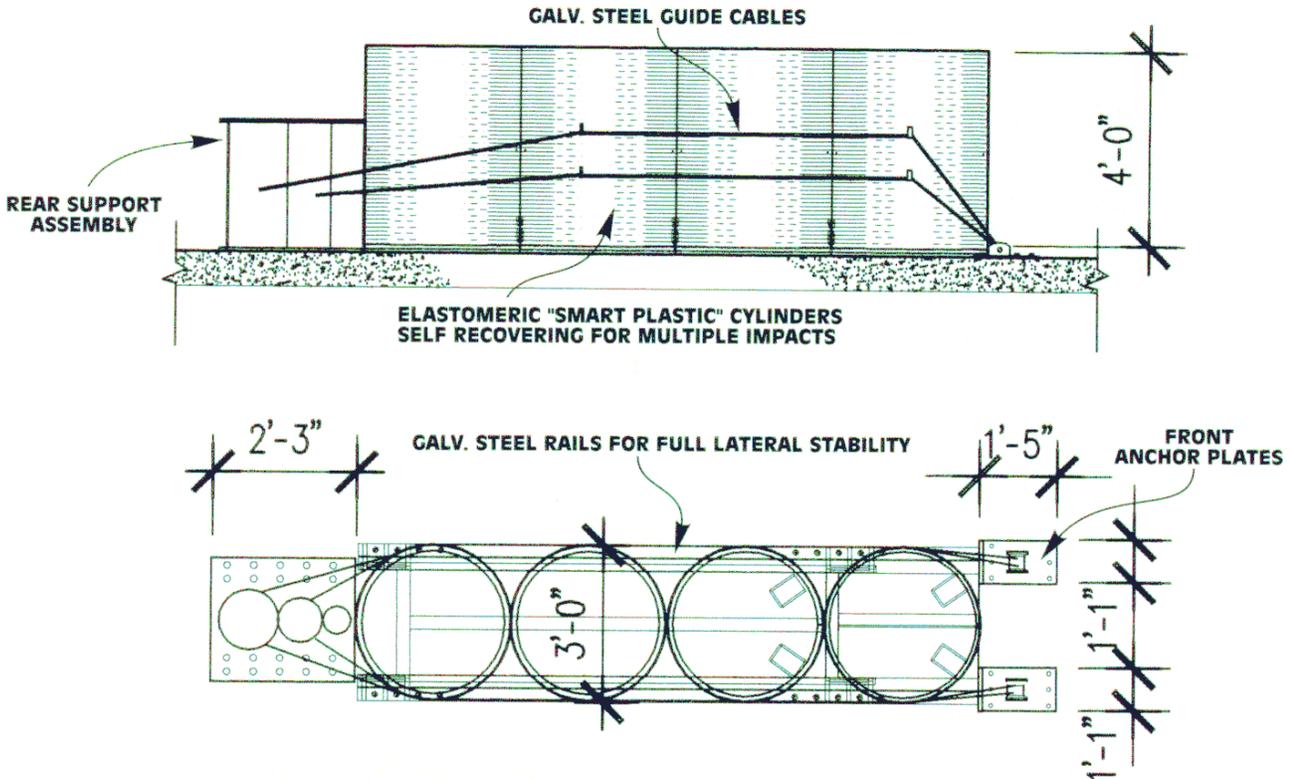
Reusable Energy Absorbing Crash Terminal



DESIGN DATA

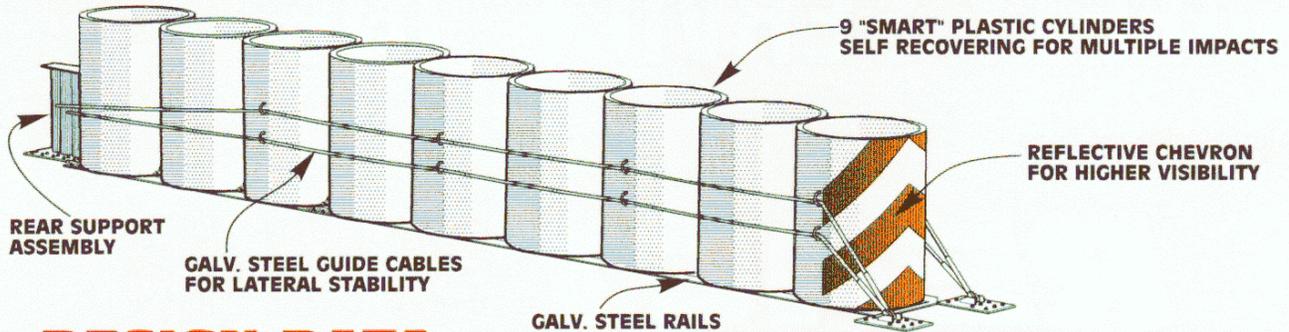
DESIGN IMPACT SPEED	44MPH (70KPH)
OVERALL UNIT LENGTH	15'-8" (4.78M)
OVERALL UNIT WIDTH	3'-0" (1.02M)
OVERALL HEIGHT	4'-0" (1.22M)
OVERALL WEIGHT	APROX. 2200 LBS (1000 KG)
DEBRIS SCATTER	NONE
REPAIR TIME	MINIMAL

TYPICAL DETAILS



REACT 350.9

Reusable Energy Absorbing Crash Terminal

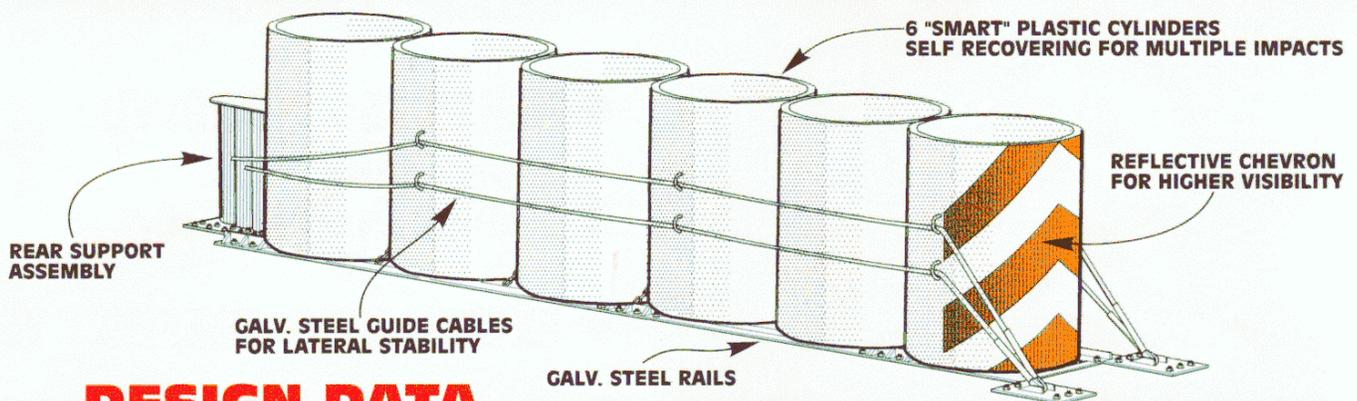


DESIGN DATA

DESIGN IMPACT SPEED	65 MPH (104 KPH)
OVERALL UNIT LENGTH	30'-8" (9.35M)
OVERALL UNIT WIDTH	3'-0" (1.02M)
OVERALL HEIGHT	4'-0" (1.22M)
OVERALL WEIGHT	APROX. 3980 LBS (1805 KG)
DEBRIS SCATTER	NONE
REPAIR TIME	MINIMAL

REACT 350.6

Reusable Energy Absorbing Crash Terminal



DESIGN DATA

DESIGN IMPACT SPEED	55MPH
OVERALL UNIT LENGTH	21'-8" (6.60M)
OVERALL UNIT WIDTH	3'-0" (1.02M)
OVERALL HEIGHT	4'-0" (1.22M)
OVERALL WEIGHT	APROX. 2430 LBS (1105 KG)
DEBRIS SCATTER	NONE
REPAIR TIME	MINIMAL

THE REACT 350 SYSTEM:

The **REACT350** refers to a unique family of crash cushions that feature reusable "smart" plastic cylinders. The system attenuates head-on impacts and redirects angle impacts. It can sustain multiple impacts without the need for costly repair. The system is designed to protect obstacles up to three feet wide. The **REACT 350** system is available in three models to accommodate different speeds.

REACT Model	Qty. <u>cylinders</u>	Design <u>speed</u>	Unit <u>length</u>	Unit <u>weight</u>
350-4	4	45 mph	15' - 8"	2590#
350-6	6	55 mph	21' - 8"	3400#
350-9	9	65 mph	30' - 8"	3980#

The **REACT350** can be used for permanent locations or temporary construction zone applications. The device can be assembled in the field or in the yard and transported completely assembled. The system can be fastened to a variety of pavement assemblies.

The **REACT350** has met the NCHRP 350 test criteria for levels I, II & III and has been approved by the FHWA. For information on individual state approvals contact the local distributor or Roadway Safety Service.

DESIGN FEATURES:

Assembled **REACT350** units are self contained and need only be anchored to the pavement. They are not connected to the obstacle in any way.

The **REACT350** system can withstand bi-directional impacts without any special parts. Simply follow the installation instructions paying close attention to the bi-directional installations paragraph on page 2.

REACT350's ability to sustain multiple impacts without the need for costly repair or immediate servicing provides a much improved solution for construction zone applications. The contractor has the option to prefabricate a concrete pad and attach the REACT unit off site. A then completed unit can be transported to the site thus reducing exposure to traffic and installation costs.

The **REACT350-4** is shipped fully assembled. The 350-6, and 350-9 require only minimal assembly making installation quick and simple.

<p style="text-align: center;">CORRECT INSTALLATION OF THE REACT350 SYSTEM IS ESSENTIAL TO ENSURE PROPER PERFORMANCE. READ THESE SIMPLE INSTRUCTION COMPLETELY BEFORE PERFORMING ANY WORK.</p>

TOOLS & EQUIPMENT:

The following equipment will be required to install REACT 350:

1. Lifting & Moving capability (minimum 5 ton capacity)
2. Roto Hammer
3. 3/4" Drill bits to drill 7" deep into hard concrete.
4. Impact wrench & 1 1/8" deep socket
5. Set of open end wrenches & pliers
6. Screw gun
7. 1/4" Hex head socket
8. 30" Crescent wrenches or 18" pipe wrenches (2)
9. Sledge hammer & long pry bar
10. Screw drivers

SITE PREPARATION:

Permanent Installation;

The manufacturer recommends the REACT350 be anchored to an 8" concrete slab with a 28 day cure strength of 4,000 psi. No reinforcement is required for permanent installations.

Temporary Installations;

For temporary construction zone applications, a prefabricated slab may be used that requires reinforcing as per the manufacturers details on page 3.

Soil substrate requirements;

Compacted base with a grade of 6% or less.

BI-DIRECTIONAL INSTALLATIONS:

Special attention should be given to the fixity of the (CMB) Concrete Median Barrier which is to be shielded. Frequently CMBs in work zones are not restrained in any way. In these cases, angled impacts from the reverse direction could result in dislodging the CMB, permitting the errant vehicle to impact the rear anchor structure of the REACT350. Hence, extreme care must be taken to ensure that the CMB is positively and securely restrained for at least 25 feet behind the REACT350 installation.

Similarly, when protecting double faced guardrail in bi-directional applications, it is most important to gradually decrease the post spacing in accordance with the AASHTO guide (pages 7-17) to ensure that no snagging behind the rear anchor can occur.

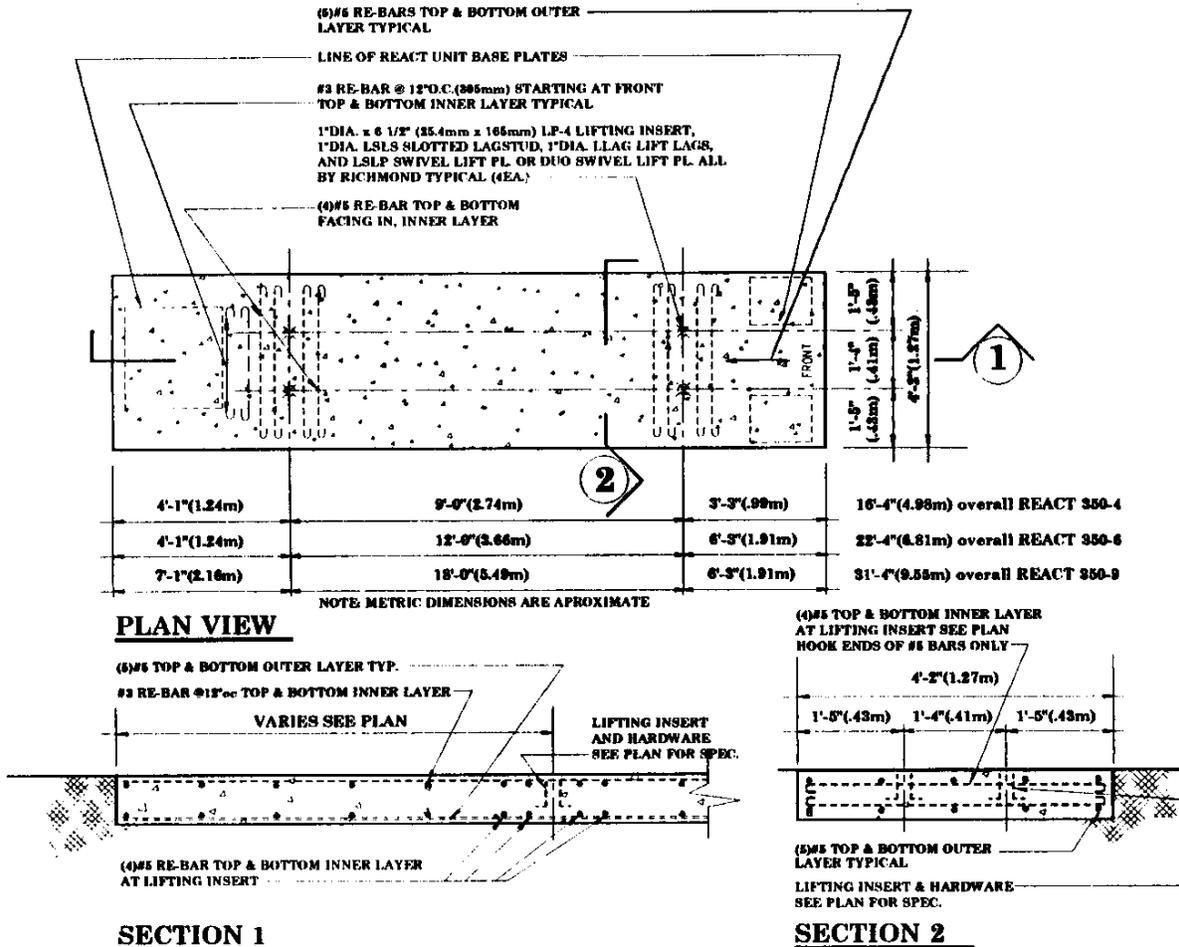
<p>NOTE: FOR FOUNDATION OPTIONS IN CONSTRUCTION ZONE APPLICATIONS REFER TO PAGE FOUR.</p>

FOUNDATION DETAILS:

Concrete Anchorage Pad (foundation type 1A) dimensions:

350 Model	slab width	x	slab length
350-4	4'-0"		17'-0"
350-6	4'-0"		23'-0"
350-9	4'-0"		33'-0"

Precast Concrete Anchorage Pad (foundation type 1B) details:



CONCRETE AND REINFORCING STEEL REQUIREMENTS:

- All concrete work and re-bar details shall conform to the latest ACI code and manual.
- Concrete and reinf. stl. work to include materials, fabrication, form work, hot or cold weather mixing, pouring and testing.
- All concrete to be 4000psi (27,580 kPa) compressive strength at 28 day test.
- All concrete shall be air entrained (6%).
- Mix proportions shall be selected based on method 2 of ACI 301.
- Max. water to cement ratio not to exceed .45 by weight. Increase slump by using approved water reducer and superplasticizer.
- Minimum cement content shall be 6.5 for 4000psi (27,580kPa) concrete.
- Maximum aggregate size 1 1/2" (38mm) for all concrete but not to exceed ACI limits.
- All reinforcing bars shall be A615 grade 60 new billet steel.
- Provide min. 2" (51mm) clear concrete cover over reinforcing steel.
- Provide #5 chair rods and metal holsters for all reinforcement as per ACI manual and CRSI Manual of Standard Practice.
- Contractor to provide continuous curing procedure for exposed concrete surfaces for the first (3) days based on ACI 308.
- All reinforcing stl. be inspected in place by owner or representative prior to pour.
- Concrete shall not be lifted from forms until it has reached 3000psi (20,685kPa).

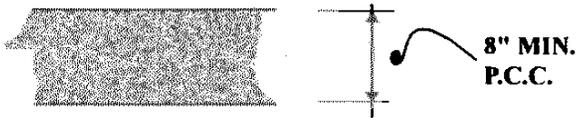
FOUNDATION REQUIREMENTS

- The soil bearing capacity is designed to be 2000 PSF (95,760Pa) and shall be verified by the contractor.

GENERAL REQUIREMENTS

- The contractor shall follow the standard construction practices determined or recommended by local or state codes and authorities. Unless specifically noted in the drawings or specifications, standard practice shall govern.
- The contractor shall verify all dimensions and elevations.
- All concrete inserts, anchors, and lifting hardware shall be as manufactured by Richmond or approved equal.

**FOUNDATION TYPE 1A :
Portland Cement Concrete (P.C.C.)**



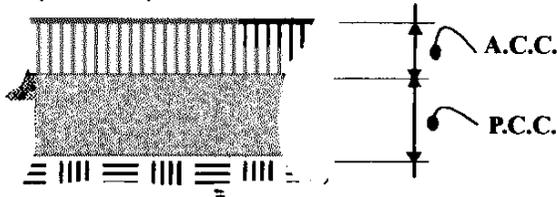
SPECIFICATIONS :

- 8" Minimum thickness
- Stone Aggregate Concrete mix :
- 4000 psi minimum compressive strength
- Anchoring system :
- Use 3/4" x 8" Drop-in anchors supplied with REACT

**FOUNDATION TYPE 1B :
Portland Cement Concrete (P.C.C.)
Precast reinforced pad (see page 3)**

- Anchoring system :
- Use 3/4" x 8" Drop-in anchors supplied with REACT

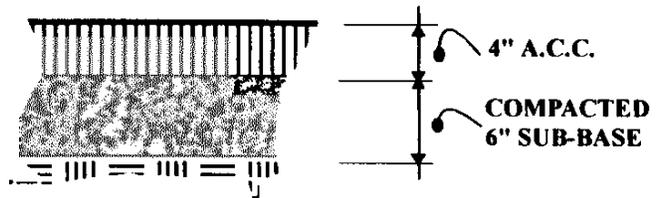
**FOUNDATION TYPE 2 :
Asphalt Cement Concrete
(A.C.C.) over P.C.C.**



SPECIFICATIONS :

- A.C.C. (per ASTM D3381 '85 or equivalent)
- 3/4" max., Medium Aggregate (Type A or B).
- P.C.C. as per foundation type 1A.
- Minimum 8" depth layer combinations;
- 0" A.C.C. & 8" P.C.C.
- 4" A.C.C. & 4" P.C.C.
- Anchoring system :
- Use 3/4" x 8" Drop-in anchors supplied with REACT

**FOUNDATION TYPE 3 :
Asphalt Cement Concrete
(A.C.C.) over Compacted Sub-base**



SPECIFICATIONS :

- A.C.C.; 4" min. (per ASTM D3381 '85 or equiv.)
- 3/4" maximum, Medium Aggregate (Type A or B)
- Compacted Sub-base; min. 6" at 95% compaction
- Anchoring system :
- 14" railroad spikes plus (6) 36" stakes as per FIG. 6

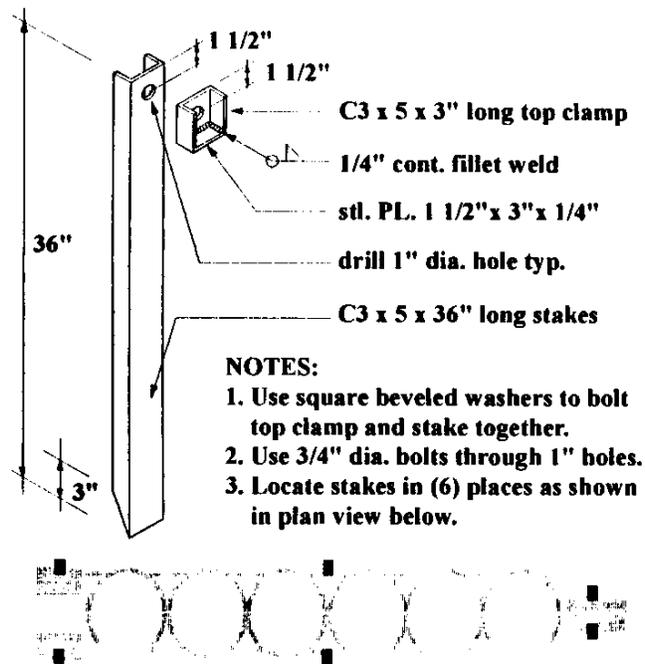


FIG. 6

**INSTALLATION OF THE REACT 350 ON ASPHALT CEMENT CONCRETE OVER
COMPACTED BASE**

Installation of the REACT 350 on asphalt is similar to the procedure described for concrete surfaces. Location of the device with relation to the hazard being protected is identical. Only the fasteners change. Instead of drilling holes for the 3/4" x 8" drop-in anchors, 3/4" x 14" railroad spikes are driven into the asphalt and compacted base with a pneumatic hammer. First drill a 3/4" diameter hole approximately 2" deep into the asphalt, using the platform as a template. Then insert the spike into the started hole and drive until the head is flush with the track. Using a cap attachment, for the hammer, which fits over the head of the spike makes driving a simple matter.

When all spikes have been installed, six 36" long channel stakes (see FIG.6) should be driven at a shallow angle adjacent to the structure at locations shown in the FIG.6 plan view. When the stakes are driven, the top clamps (also shown in FIG.6) are bolted to the stakes holding them in contact with the track or plate structure.

INSPECTIONS:

Because the REACT 350 is designed to sustain multiple impacts with little or no refurbishment, it is sometimes difficult to detect whether or not the device has been hit or if it requires servicing. A simple drive-by inspection is usually sufficient to determine if an impact has occurred. Look for the following:

Damage to the reflectors mounted on the front or sides of the cylinders.
Scrape marks on the black finish of the cylinders.
Sagging cables.

If any of these conditions are present, a more complete inspection is warranted to determine if any servicing is required. The following check list should also be used for periodic inspections:

1. Anchor Bolts:
Check all anchors to see if any have worked loose. There should be no clearance under any of the nuts. Re tighten nuts and add washers if necessary.
2. Lateral Resistance Cable:
The steel cables should be taut. If loose, tighten the nuts at the rear anchor.
Frayed cables should be replaced.
3. Stabilizer Rods & Lateral Support Chain Assemblies:
The stabilizer rods are inside the steel channels that run under the cylinders. If the rods are severely deformed (bent 6" from their original shape) they must be replaced. Refer to the repair instructions.
Check the chain assemblies to ensure they can slide on the stabilizer rod freely.
Check the shackles to ensure the pins are secure.
4. Length of the Device:
Verify the cylinders have returned to their original shape by checking the overall length of the device. Check the dimension from the back of the rear cylinder to the front of the first cylinder. This dimension should be approximately three feet x number of cylinders in the device. If the actual length is less than that dimension by a foot or more then the cylinders must be repositioned. Refer to the repositioning instructions.
5. Cylinders:
Inspect the condition of the individual cylinders for signs of material failure. Any creaked or split cylinders should be replaced. Check for tears at bolt penetrations or discolorations which may indicate material fatigue.

INSTRUCTIONS FOR REPOSITIONING:

The vast majority of impacts will require no maintenance to the system. There are however, certain severe impacts that may require repositioning the cylinders. After a high velocity impact on the nose of the device the cylinders may return to only about 90% of their original shape. The cylinders must then be overextended to return to the precollision configuration. The procedure requires the following:

TOOLS -

1. Truck with 2 ton hauling capacity.
2. REACT 350 pull out tube assembly included with every unit.
3. Approximately 10 feet of chain.
4. Long pry bar.
5. 30" crescent wrenches or 18" pipe wrenches (2)
6. Broom.
7. Screw driver.

PROCEDURE -

1. Set up traffic controls as required by the local jurisdiction. Back up to the REACT 350 unit nose with a 2 ton capacity vehicle.
2. Sweep the area clean of debris.
3. Remove the cable nuts and washers and pull cables out of the rear steel anchor post; replace the nuts and pull the cables forward until the nuts stop against the U bolts on the side of the cylinders. Loop loose cable as pictured so that the cylinder pull out will not snag the cable swagging.
4. Place the pull out tube inside the first cylinder so that the threaded rod penetrates the wall of the cylinder at the predrilled holes in the front of the cylinder. Fasten the eye bolt on the threaded rod and attach the pull chain.
5. Attach the chain to the truck at or above the height of the eye bolt (27" above grade).
6. Slowly draw the pull chain taught and over extend the cylinders as follows:

4 cylinder units	6" beyond the front edge of the anchor plate
6 cylinder units	9" beyond the front edge of the anchor plate
9 cylinder units	12" beyond the front edge of the anchor plate

Maintain the taught position for 3-5 minutes by standing on the brakes.
7. Slowly release the chain, remove the chain and pull out tube assembly. Align the cylinders on the base tracks using a pry bar as required.
8. Pull the cable back to the rear anchor post and reattach, hand tighten the nuts only. Then torque the cables down with the wrench to about a 1/4" slack when depressed by hand.

INSTRUCTIONS FOR REPLACING STABILIZER RODS:

A high velocity impact on the side or rear of the device may bend the stabilizer rods that run parallel to the steel angle under the cylinders. The procedure to replace these rods is as follows;

TOOLS

1. Replacement bar provided by the manufacturer.
2. 30" Crescent wrenches or 18" pipe wrenches (2).

PROCEDURE

1. Remove the nuts at both ends of the rod to be replaced (see figure below).
2. Remove the bent rod by sliding it through the end connection. If the rod is too badly deformed to slide out, cut the rod as required with a welding torch.
3. Install the new rod by sliding it into place from one end. Be sure to pass the rod through all the shackles on the chain assemblies as you slide it into place. Replace the end nuts and tighten.



WIDE REACT

B8

Information on WIDE REACT

At the present time, information on WIDE REACT is not available.

We hope to have information in the near future.



ENERGITE SYSTEM

C1

Contains:

Internet Information

Design Criteria

Wide Hazard Protection

For general and the latest information on Energite Systems, please refer to www.energyabsorption.com.

The following is in addition to the information provided at the above website.

DESIGN CRITERIA

Before selecting inertial barriers as the attenuator for any given site, certain conditions of the site and the system must be taken into consideration. Table 1 lists the recommendations of the Federal Highway Administration (FHWA) and the Energy Absorption Systems, Inc., for these site conditions.

The Energite III System is a nonredirective crash cushion and should be used appropriately.

SPECIAL SITE CONDITIONS

Other special conditions warrant consideration in the design and installation of inertial barrier systems. The following conditions and recommendations for treatment are based on performance observations.

1. Freezing temperatures:

In cold climates, sand having a moisture content of 3% or more should be mixed with 5% rock salt (by weight) to prevent the sand from freezing into potentially dangerous solid blocks.

2. Modules placed on structures:

On structures where the vibrations from moving traffic may cause modules to shift, steel or formed-in-place asphaltic concrete half-rings placed on the downhill side of the modules will prevent such movement. Also, nails or bolts through the bottom of the outer container and into the roadway will prevent module movement.

3. Partial impacts:

When a vehicle contacts less than the full width of a module, the module's deceleration effectiveness is equivalent to the percentage of the module contacted. If half of the module is impacted, then only 50% of that module's weight is effective and should be kept in mind when placing an array.

4. Other unique conditions:

You may find that there are other conditions unique to a particular site that must be considered to ensure a properly designed and functional inertial barrier system.

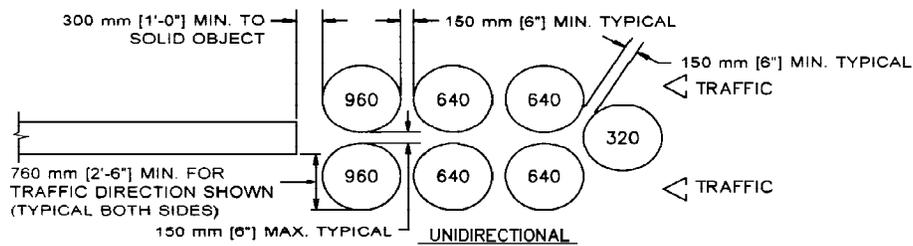


FIGURE 1

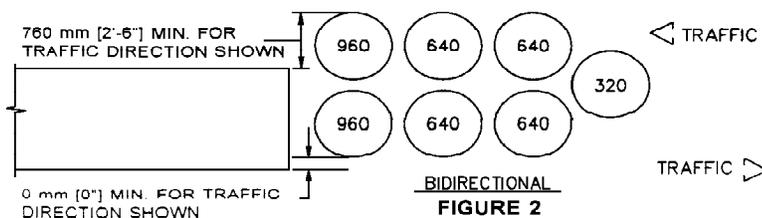
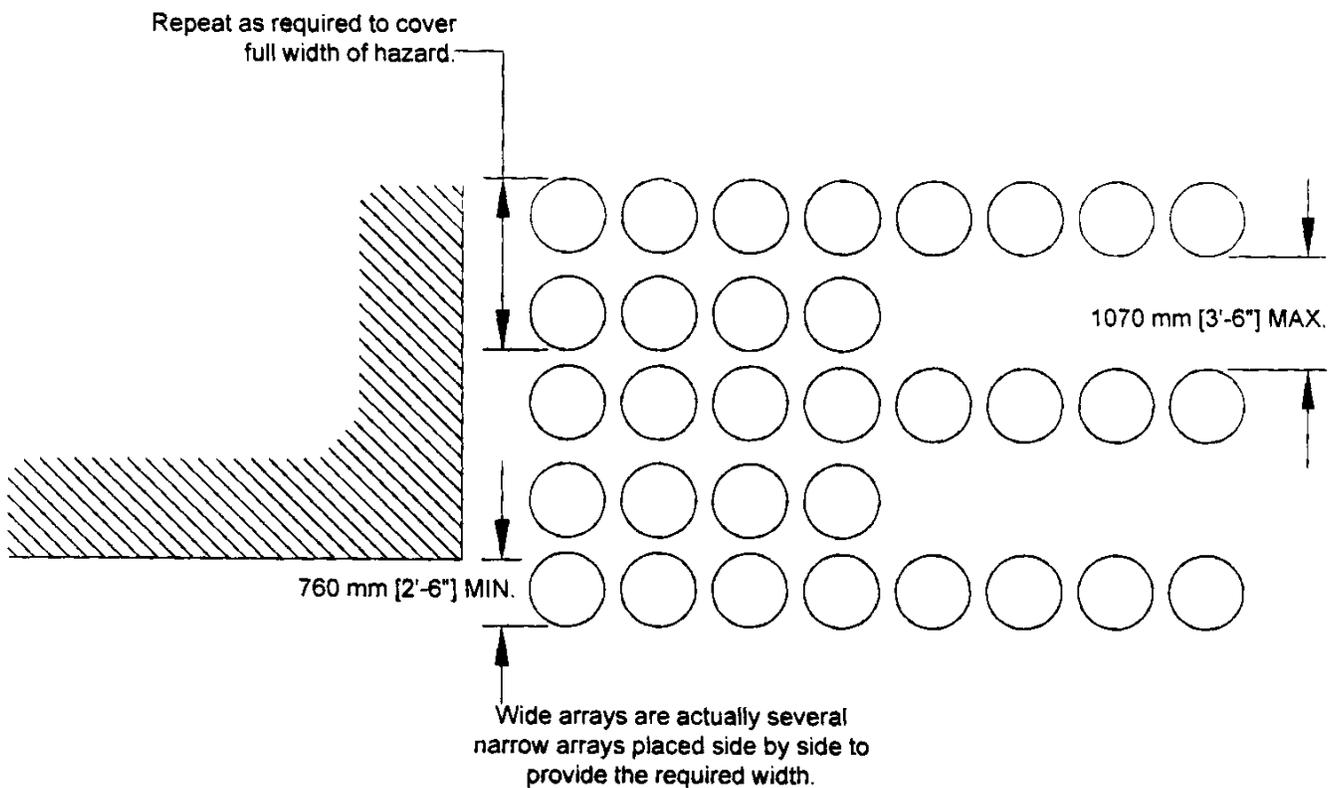


FIGURE 2

Conditions	FHWA Recommendations	Energy Absorption Recommendations	Sample
1. Angle of array in relation to center line of obstacle.	Not recommended for more than 10°	Same as FHWA	
2. Bidirectional traffic	Offset array to avoid impact to the rear module from wrong-way vehicles (See Fig.2 Pg. 4)	Same as FHWA	
3. Module spacing: module to module module to hazard	None given 300 to 610 mm [1' to 2']	Same as FHWA	
4. "Coffin" corner	Shield 760 mm [30"] outside of hazard (See Figs. 1 & 2 Pg. 4)	Same as FHWA	
5. Sloping sites (lateral and longitudinal)	5% grade maximum	Same as FHWA	
6. Curbs and raised islands	No more than 100 mm [4"] high	Remove all curbs and raised islands	
7. Foundation pads	Flat surface; concrete or asphalt	Same as FHWA	
8. Intermixing of brands of modules	Approved - As long as modules are federally approved and array meets design criteria.	Same as FHWA	
9. Maintenance	Keep site clear of debris and snow	Same as FHWA	
10. Sand densities	1600 kg/m ³ [100 lbs/cf]	Determine in the field	
11. Single rows of modules	Not recommended	Same as FHWA	
12. Vandalism	Check periodically for damages	Same as FHWA	

WIDE HAZARD PROTECTION

Energite® III Systems are effective for shielding very wide hazards where redirective properties of the crash cushions are not a consideration. The array may be kept wide at the front to achieve optimum protection across the full width to maximize available recovery area for gore areas. The array design depends on the site conditions and expected vehicle trajectories.





FITCH UNIVERSAL MODULE

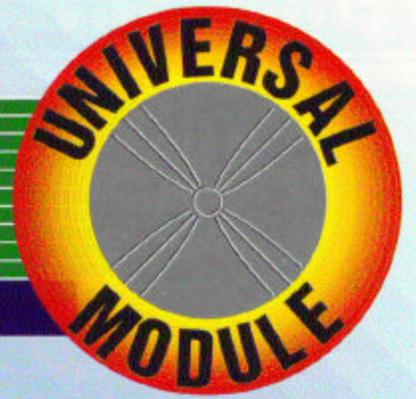
C2

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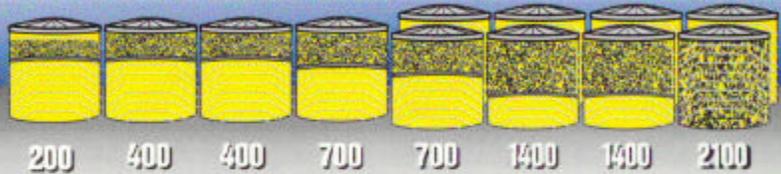
Fitch Universal Module Photos

FITCH

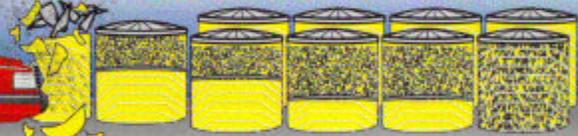
SAND FILLED CRASH BARRIER



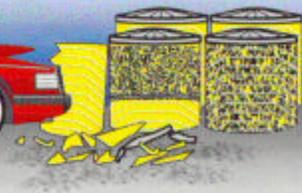
SAVE LIVES!



PREVENT INJURIES!



LOWER PROPERTY DAMAGE!



ROADWAY SAFETY SERVICE, INC.

700-3 UNION PARKWAY · RONKONKOMA, NY 11779

516-588-6200 · FAX 516-588-6394

FITCH UNIVERSAL MODULE

PERFORMANCE CHARACTERISTICS



INDIVIDUAL UNIVERSAL MODULE

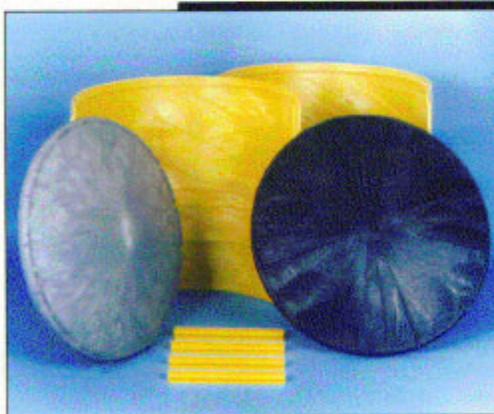
- ◆ Fitch barrels are the safest, most cost effective impact attenuator on the market today.
- ◆ The Fitch module has experienced over 10,000 impacts, preventing injuries and reducing property damage.
- ◆ Modules are designed to handle impacts from compact cars to pick-up trucks without ramping, meeting all requirements of NCHRP 350.



STANDARD ARRAY

EASY TO ASSEMBLE AND MAINTAIN

- ◆ Patented Zip Strips allow efficient reactivation while lowering cost and cutting set-up time.
- ◆ No training or special tools required for assembly.
- ◆ Guaranteed against fading or cracking for five years.

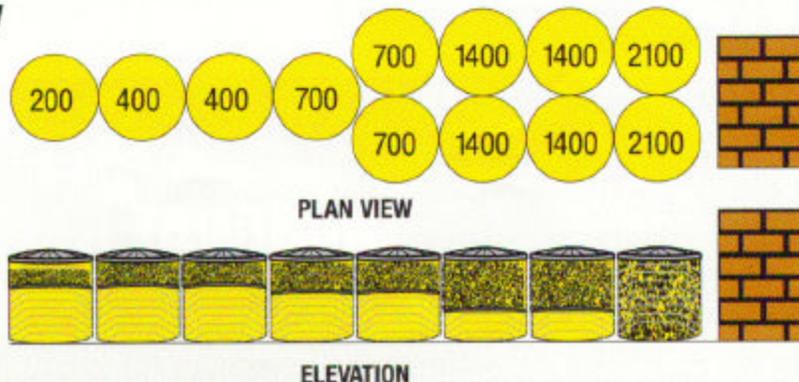


One set of walls, one core, one lid, and four Zip Strips will make any weight module required.

- ◆ The exclusive Unicore eliminates the need to maintain a large inventory of assorted parts.
- ◆ The One-Size-Fits-All concept provides the most versatile crash cushion available.
- ◆ After replacing impacted units the system is restored to 100% safety efficiency.

SAND WEIGHT DISTRIBUTION

Typical Barrier Array



**REPAIR AFTER A GLANCING HIT CAN BE COSTLY AND TIME CONSUMING...
NOT ANY MORE!**



Many of the hits on inertial barriers are glancing, nuisance hits causing a small hole or damaging only one half of the module.

Fitch Universal Modules not only save time on installation, but also save time and money on repairs: simply orient the **Zip Strips** towards oncoming traffic. A grazing impact now hits only one side of the module. This leaves the **Zip Strips** and the other side of the module intact, reducing the cost of replacement parts and making for less clean-up.

AVERAGE "G" FORCES IN RELATION TO BARRIER LENGTH

BARRIER CONFIGURATION	35 MPH	40 MPH	45 MPH	50 MPH	55 MPH	60 MPH	65 MPH
35 MPH 	4.55 g's 3.41 g's						
40 MPH 	3.41 g's 2.73 g's	4.46 g's 3.56 g's					
45 MPH 	2.73 g's 2.27 g's	3.56 g's 2.97 g's	4.51 g's 3.76 g's				
50 MPH 	2.73 g's 1.95 g's	3.56 g's 2.55 g's	4.51 g's 3.22 g's	4.64 g's 3.98 g's			
55 MPH 	2.27 g's 1.70 g's	2.97 g's 2.23 g's	3.76 g's 2.82 g's	4.64 g's 3.48 g's	4.81 g's 4.21 g's		
60 MPH 	1.95 g's 1.51 g's	2.54 g's 1.98 g's	3.22 g's 2.50 g's	3.98 g's 3.09 g's	4.81 g's 3.74 g's	5.01 g's 4.45 g's	
65 MPH 	1.70 g's 1.36 g's	2.23 g's 1.78 g's	2.82 g's 2.25 g's	3.48 g's 2.78 g's	4.21 g's 3.37 g's	5.01 g's 4.01 g's	5.23 g's 4.79 g's

Legend - 1800 lb. vehicle = plain text 4500 lb. vehicle = bold text



TRAFFIX

C3

Contains:

Internet Information

For general and the latest information on TrafFix, please refer to www.traffixdevices.com.



NEAT

D1

Contains:

Internet Information

For general and the latest information on NEAT, please refer to www.energyabsorption.com.



TRITON BARRIER

D2

Contains:

Internet Information

TRITON BARRIER Specifications

TRITON BARRIER Length of Need

For general and the latest information on Triton Barrier, please refer to www.energyabsorption.com.

The following is in addition to the information provided at the above website.

Triton Barrier Specifications

The following are general specifications for the Triton Barrier. Additional information is available in the Product Manual for this system. Contact Energy Absorption SYstems for details.

Length	2 m (78")
Height	0.8 m (32")
Width	0.5 m (21")
Empty Weight	65 kg (140 lb)
Full Weight (water)	610 kg (1,350 lb)
Water Ballast	550 liters (145 gall

LENGTH OF NEED

Length of need (L.O.N.) is defined as the total length of a longitudinal barrier needed to shield an area of concern (1). It is also described as that part of a longitudinal barrier or terminal designed to contain and redirect an errant vehicle (2). The TRITON BARRIER® end treatment is 20 meters [65 ft.] which is 10 sections long. The Beginning Of Length Of Need (B.L.O.N.) is 10 meters [33 ft.] from the end of the TRITON BARRIER (refer to Figure 21). The minimum length of TRITON BARRIER needed is 30 meters [100 ft.] which is 15 sections of as shown in Figure 22.

(1) AASHTO Roadside Design Guide, 1989

(2) NCHRP 350

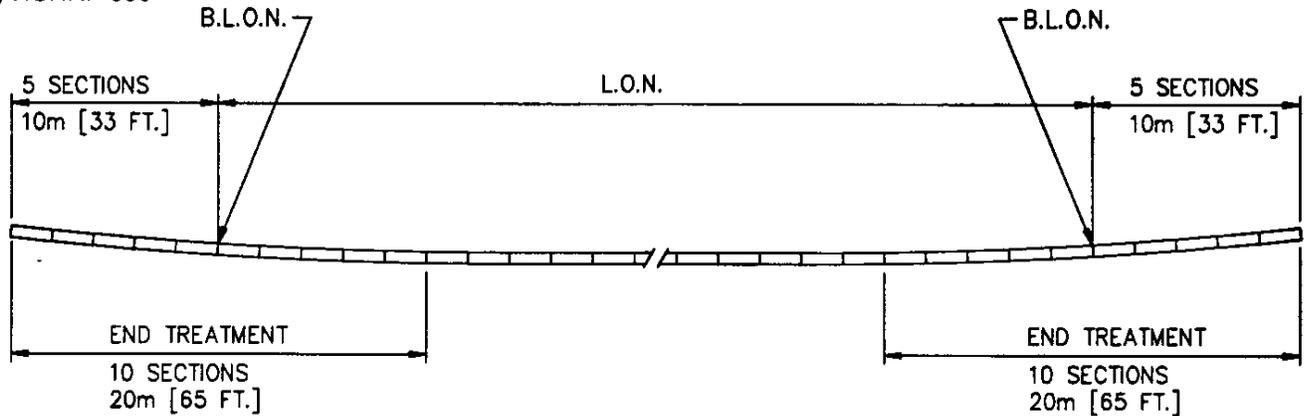


FIGURE 21
L.O.N. FOR UNI-DIRECTIONAL OR BIDIRECTIONAL TRAFFIC

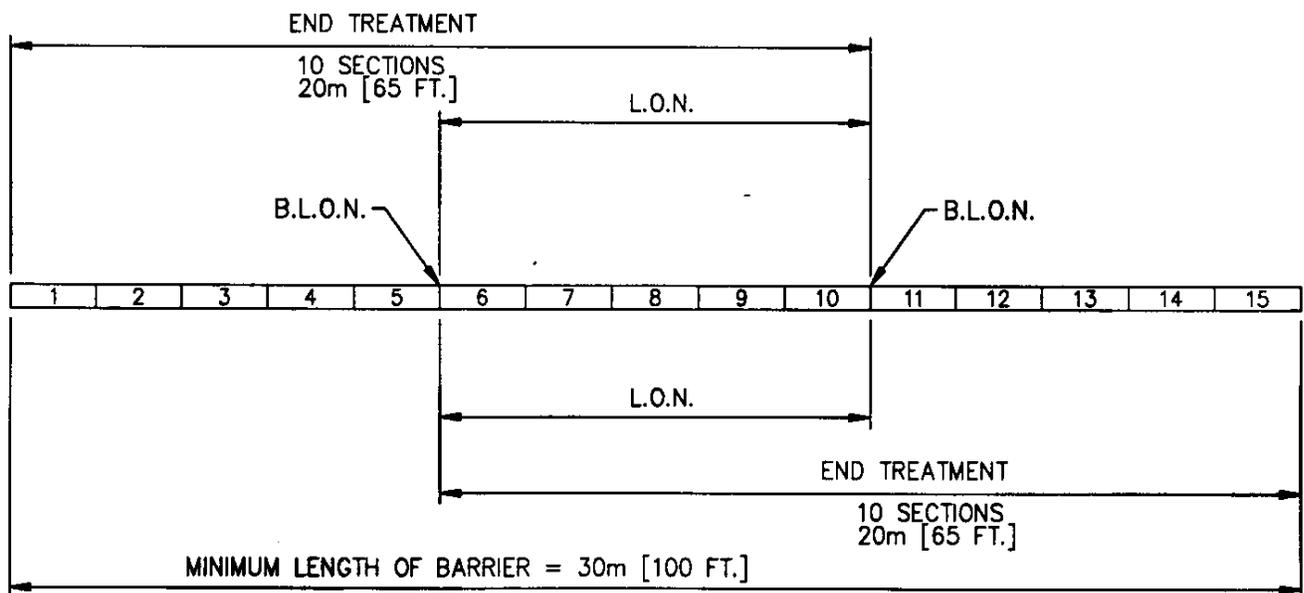


FIGURE 22
MINIMUM LENGTH LAYOUT FOR TRITON BARRIER

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(2) NCHRP 350

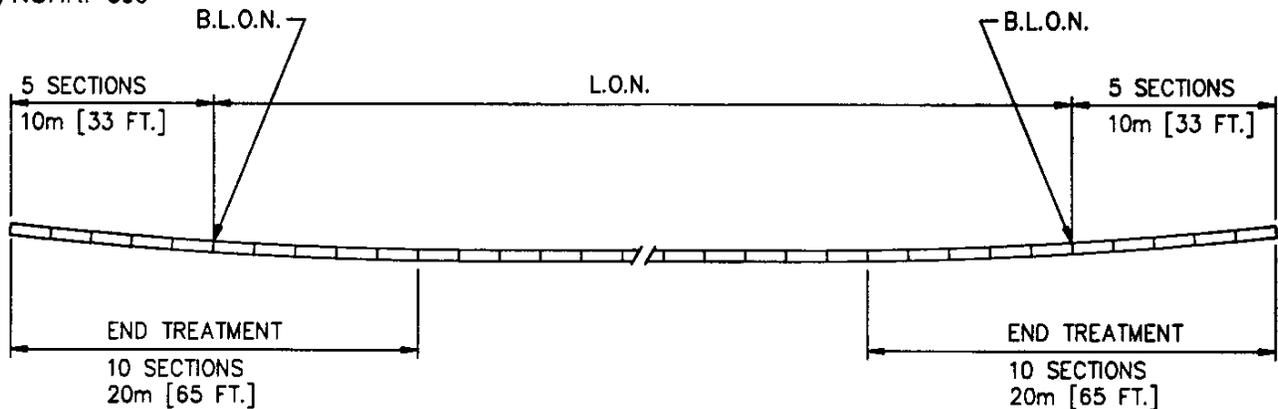


FIGURE 21
L.O.N. FOR UNI-DIRECTIONAL OR BIDIRECTIONAL TRAFFIC

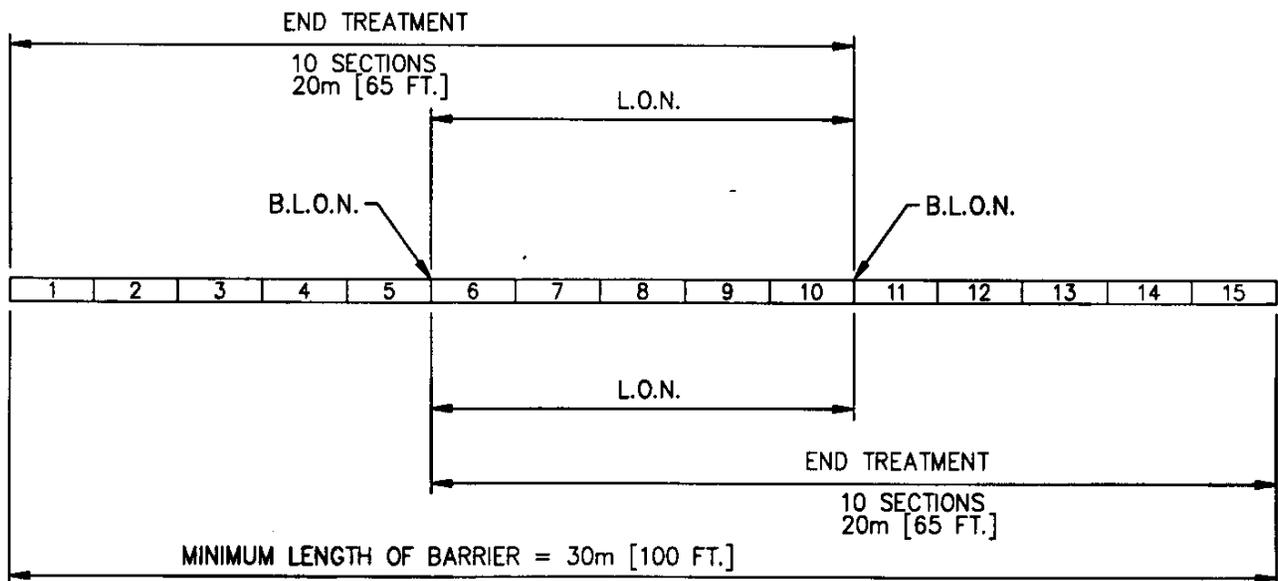


FIGURE 22
MINIMUM LENGTH LAYOUT FOR TRITON BARRIER



GUARDIAN SAFETY BARRIER

D3

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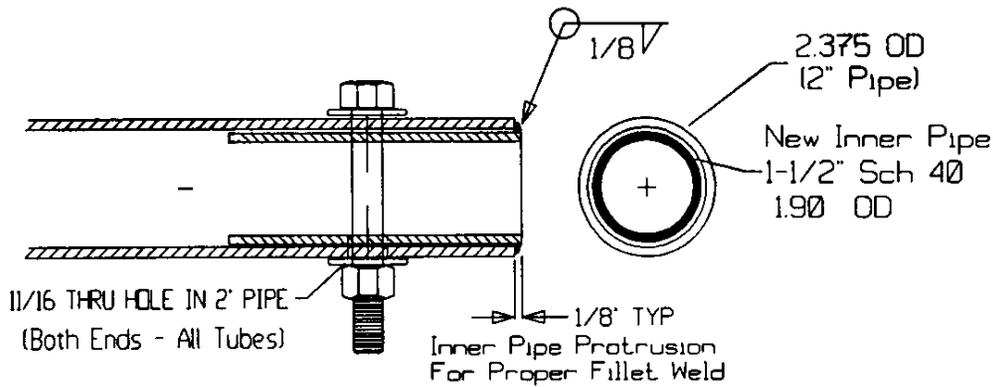
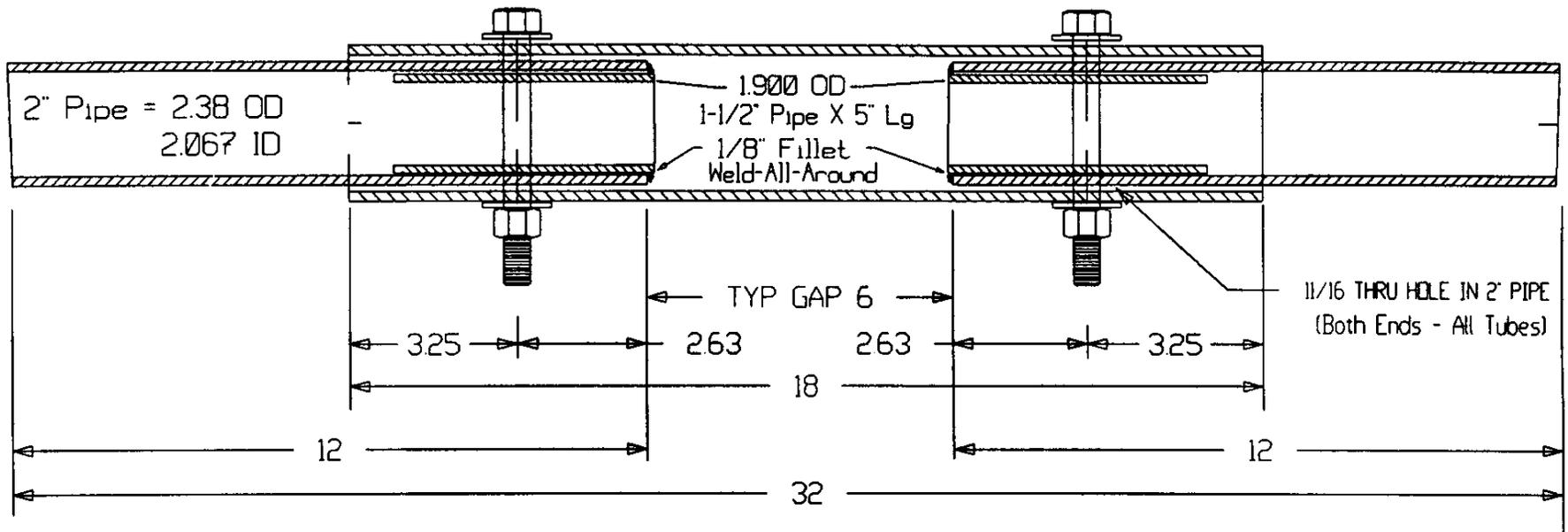
Internet Information

Views of the GUARDIAN SAFETY BARRIER

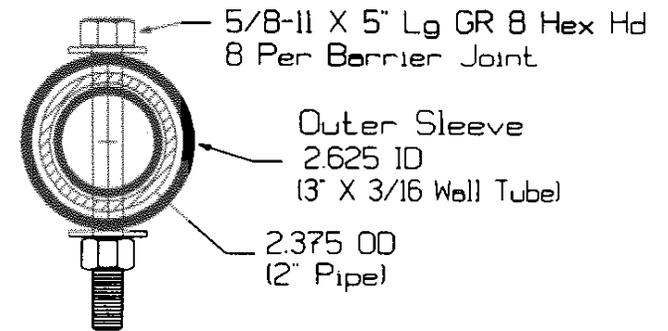
For general and the latest information on Guardian Safety Barrier, please refer to www.barriers.com.

The following is in addition to the information provided at the above website.

FRONT ELEVATION VIEW



END ELEVATION

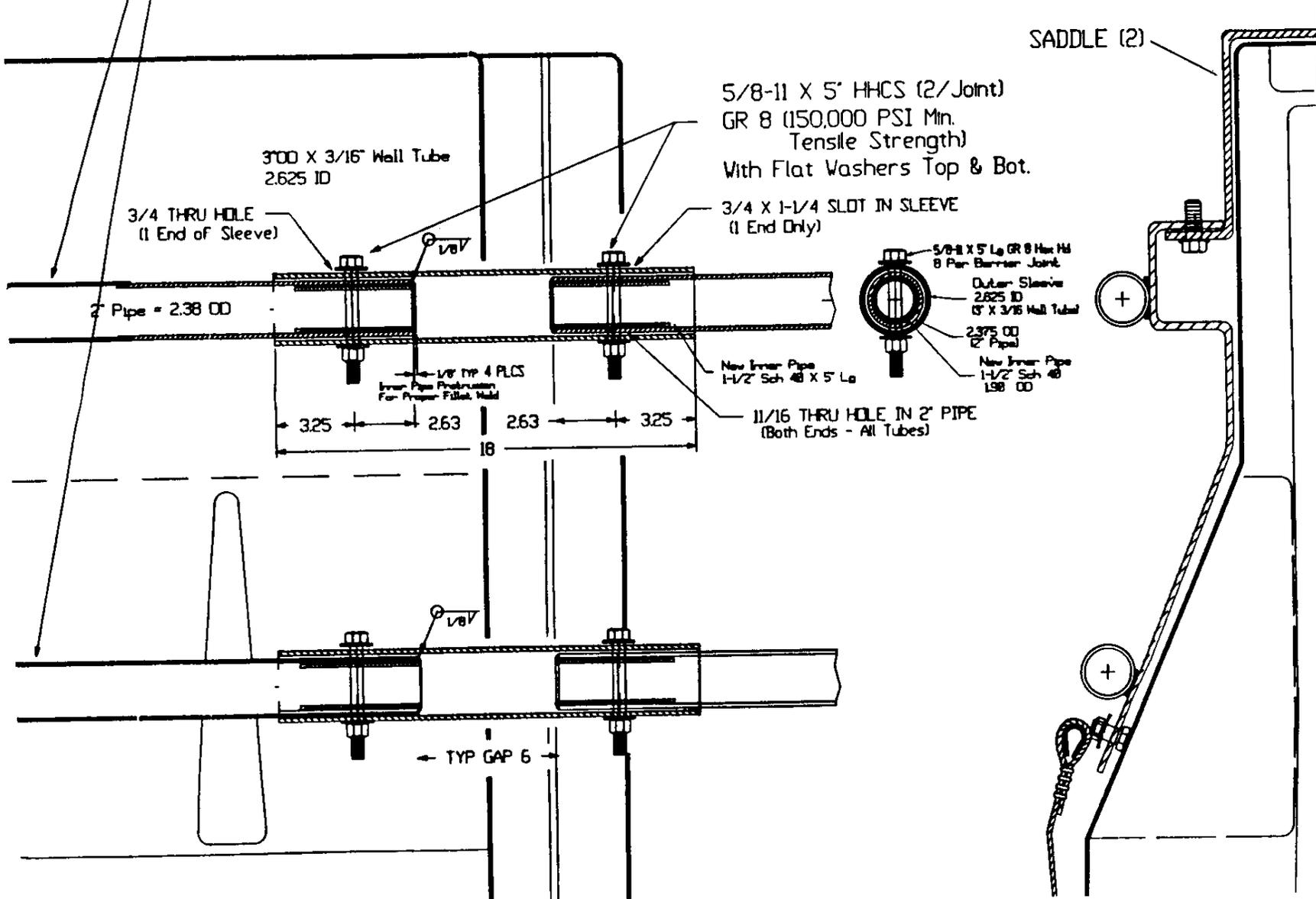
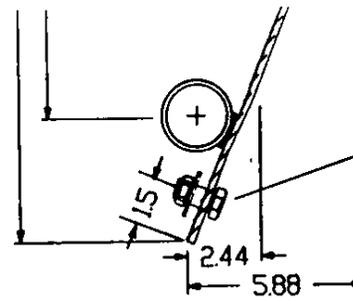


GUARDIAN
350 HIGHWAY KIT™

05 Aug 96
Rev'd 21 Jan 97
Rev'd 03 Feb 97

REVISED LEVEL 3
JOINT DESIGN
project direction inc
SBSKIT62 GCD

2" Schedule 40
ASTM A120 WELDED
2 - 66" LENGTHS
(4 PER BARRIER)





CUSHION WALL

D4

Contains:

[Internet Information](#)

For general and the latest information on Cushion Wall, please refer to www.energyabsorption.com.



BARRIERGATE

D5

Contains:

Internet Information

For general and the latest information on BarrierGate, please refer to www.energyabsorption.com.