



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

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

February 9, 2011

In Reply Refer To:
HSST/CC-112

Mr. Barry D. Stephens, P.E.
Sr. Vice President Engineering
Energy Absorption Systems, Inc.
3617 Cincinnati Avenue
Rocklin, CA 95678

Dear Mr. Stephens:

This letter is in response to your request for the Federal Highway Administration (FHWA) acceptance of a roadside safety device for use on the National Highway System (NHS).

Name of device: 6-bay QuadGuard[®] M10; and,
6-bay QuadGuard[®] M10 Wide
Type of device: Impact Attenuator and Transitions
Test Level: AASHTO Manual for Assessing Safety Hardware (MASH)
Test Level 3 (TL-3)
Testing conducted by: E-Tech Testing Services, Inc.
Date of request: May 3, 2010
Date of completed package: July 23, 2010
Task Force 13 Designator(s): SCI26 (M10)
SCI27 (M10 Wide)

You requested that we find these devices acceptable for use on the NHS under the provisions of the MASH testing standard.

Requirements

Roadside safety devices should meet the guidelines contained in the MASH. The FHWA Memorandum "**ACTION**: Identifying Acceptable Highway Safety Features" of July 24, 1997, provides further guidance on crash testing requirements of longitudinal barriers.

Decision

The following devices are acceptable, with details provided below:

- 6-bay QuadGuard[®] M10 (M10)
- 6-bay QuadGuard M10 Wide (M10W)
- QuadGuard M10 transition to W-beam
- QuadGuard M10 transition to thrie-beam
- QuadGuard 4inch offset transition to Concrete Median Barrier



- QuadGuard 9inch offset transition to Concrete Median Barrier
- QuadGuard transition to vertical wall

Description

The M10 and M10W are redirective, non-gating 6-bay crash cushions. The MASH design has been revised from NCHRP Report 350 (Report 350) design to now include a reinforced lower front bracket, a new upper front bracket and new cartridge types. Features of both M10 and M10W systems are shown in the enclosed drawings for reference.

The M10 and M10W systems have an overall length of 22 feet, 0 inches. [6.71 m]. The M10 can be configured with backup widths of 24 inches [610 mm], 30 inches [762 mm], and 36 inches [914 mm]. The M10W can be configured with back-up widths of 69 inches [753mm] and 90 inches [2285 mm]. The overall height of both M10 and M10W is 32 inches [817 mm]. The system consists of energy absorbing cartridges surrounded by a framework of steel Quad-Beam™ guardrail that can telescope rearward during head-on impacts. The system has a center monorail that will resist lateral movement during side angle impacts and a back up structure that will resist movement during head-on impacts.

Components from the 5-Bay QG II unit that are used on the new 6-Bay QG M10 unit are:

1. QG foundation–anchored center Monorail
2. QG Fender Panels
3. QG Diaphragms
4. QG Backup
5. MP-3™ Concrete Anchors
6. 14ga steel wrap-around sheet metal Nose
7. 50mm [2 inches] Lower Nose Cartridge Bracket
8. 10ga steel rail guide Shims

Components that were enhanced to achieve the required performance include:

1. QG Type M-I cartridges (4 required)
2. QG Type M-II cartridges (3 required)
3. A hold down bracket was added to the nose cartridge to contain the cartridge and maximize its energy absorption.
4. The bottom nose cartridge bracket attached to the diaphragm was reinforced to help restrain the cartridge to maximize its energy absorption.
5. Transition Hardware – steel posts (only) in strong soil

System drawings are also included within this correspondence for review and reference.

Crash Testing

Full-scale crash tests were conducted into the new QG M10 as required per MASH under the TL-3 guidelines. For the M10 system, MASH Tests 3-31 was conducted on the 24-inch

[610 mm] system and MASH Test 3-32 was conducted on the 36-inch [914 mm] system. The test results are as follows and can also be reviewed in enclosed MASH Test Matrix:

Test 3-31:

Impact speed = 99.0 km/h

Ridedown = -17.6 g's

Longitudinal ΔV = 8.4 m/s

Test 3-32:

Impact speed = 97.0 km/h

Ridedown = -17.8 g's

Longitudinal ΔV = 11.1 m/s

Due to a higher energy of the MASH test vehicles, test 3-34 and test 3-36 were conducted on the 24-inch [610 mm] system in addition to the newly specified test 3-37. The results of these tests are as follows:

Test 3-34:

Impact speed = 102.5 km/h,

Longitudinal ridedown = -10.6 g's

Longitudinal ΔV = 8.9 m/s

OCD: AS1020000

Test 3-36:

Impact speed = 99.0 km/h,

Lateral ridedown = 14.2 g's

Lateral ΔV = 7.4 m/s

OCD: AS1110000

Test 3-37:

Impact speed = 99.7 km/h,

Longitudinal ridedown = 7.8 g's

Longitudinal ΔV = -7.8m/s

OCD: LF0030000

For the M10W system, a comparison was made using existing Report 350 crash test results for the 5-bay QG II (flared) and original QG (parallel) systems. Since the results of these tests indicated that test 3-31 and 3-32 are similar for parallel and flared systems, equivalence to the Report 350 device in lieu of further testing of the M10W systems, with backup widths of 69-inch [753mm] and 90-inch is requested.

A discussion regarding the M10 and M10W transition systems was conducted with FHWA Office of Safety on March 16, 2010. It was agreed the M10 to W-beam transition represents a worst case condition for pocketing and snagging of the test vehicle. In addition and in this particular case, the MASH test 3-21 is considered equivalent to test 3-37. In addition, a successful test 3-37 would serve to represent all of the following submitted transitions with

caveat that required spacing and specification of steel posts for w-beam transition must also be the same for M10 transition to thrie-beam to provide similar system strength:

1. Transition QG M10 to W-beam
2. Transition QG M10 to thrie-Beam
3. QG 4" offset Transition to CMB
4. QG 9" offset Transition to CMB (No wide system version)
5. Transition QG to vertical wall
6. QG 6" offset transition to single slope barrier

In addition, per MASH Section G computations (using existing tests 3-31 result), a waiver is requested of test 3-38 (1500A crash test).

Findings

The M10 and M10W systems meet evaluation criteria as per MASH for a redirective, non-gating crash cushion at TL-3 impact conditions. Therefore, these systems are acceptable for use on the NHS when such use is acceptable to the contracting authority. In addition, the M10 can be installed with aforementioned transition hardware with caveat that steel posts with a specified spacing are used for W-beam and thrie-beam transitions as described in test 3-37 report. Please note the following standard provisions that apply to the FHWA letters of acceptance:

- This acceptance is limited to the crashworthiness characteristics of the devices and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the device will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the device being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke our acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance, and that it will meet the crashworthiness requirements of the FHWA and the MASH.
- To prevent misunderstanding by others, this letter of acceptance is designated as number CC-112, and shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed at our office upon request.
- The QuadGuard[®] M10 attenuators are patented products and considered proprietary. If proprietary devices are specified by highway agency for use on Federal-aid projects, except exempt, non-NHS projects, (a) they must be supplied through competitive bidding with equally suitable unpatented items: (b) the highway agency must certify that they are essential for synchronization with the existing highway facilities or that no equally suitable

- alternative exists: or (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.
- This acceptance letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented device for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate device, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely,

A handwritten signature in blue ink that reads "Michael S. Griffith". The signature is written in a cursive, flowing style.

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

Enclosures



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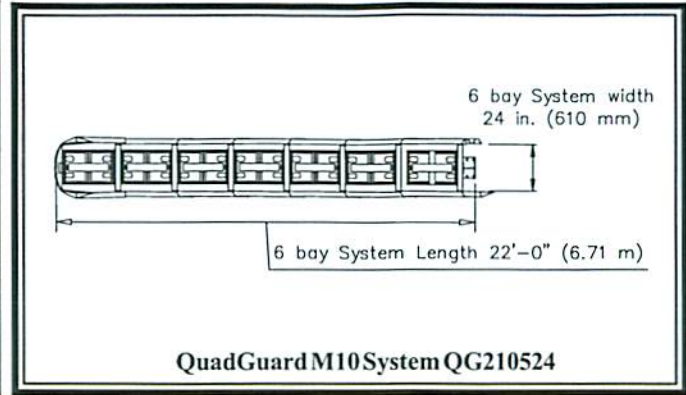
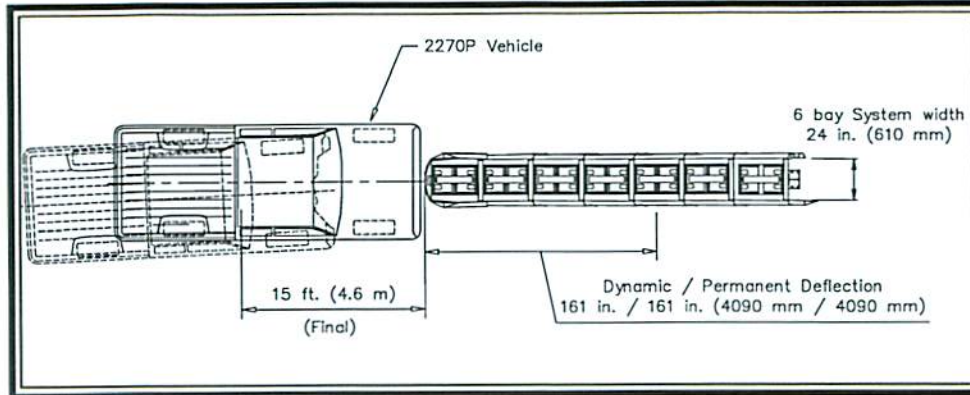
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E-TECH Testing Services, Inc.

QuadGuard® M10 Crash Test Results - 17 of 86

General Information

Test Agency E-TECH Testing Services, Inc.
 Test Designation MASH Test 3-31
 Test No. 01-3044-004
 Date 2/25/10

Test Article

Type Energy Absorption System
 QuadGuard M10 System QG210524
 Installation Length 6 bay 22 ft. (6710 mm) long
 24 in. (610) mm wide
 Material and key elements (7) energy absorbing cartridges
 (4) Type M-I and (3) Type M-II
 AASHTO M180 Quad Panels
 ASTM A36 other, galvanized
 steel construction
 Foundation Type and Condition Unreinforced 27.6 Mpa concrete,
 clean and dry, with (52) 19 mm x
 178 mm ASTM A193 Grade B-7
 threaded studs and
 MP-3 Anchoring System

Test Vehicle

Type Production Model
 Designation 2270P
 Model 2004 Dodge 1500 Quadcab Pickup
 Mass
 Curb 4773 lb (2165 kg)
 Test inertial 4998 lb (2267 kg)
 Dummy N/A
 Gross Static 4998 lb (2267 kg)

Impact Conditions

Speed 61.5 mi/h (99.0 km/h)
 Angle (deg) 0
 Impact Severity 632.0 ft-kip (857.0 kJ)
 Exit conditions
 Speed N/A
 Angle (deg - veh. c.g.) N/A

Occupant Risk Values

Impact Velocity
 x-direction 26.6 ft/s (8.4 m/s)
 y-direction 0.3 ft/s (0.1 m/s)
 Ridedown Acceleration (g's)
 x-direction -17.6
 y-direction 1.5

European Committee for Normalization (EN) Values

THIV 18.9 mi/h (30.3 km/h)
 PHD (g's) 17.6
 ASI 1.2

Post-Impact Vehicular Behavior (deg - rate gyro)

Maximum Roll Angle -2.7
 Maximum Pitch Angle -9.0
 Maximum Yaw Angle -3.2

Test Article Deflections

Dynamic 161 in. (4090 mm)
 Permanent 161 in. (4090 mm)

Vehicle Damage (Primary Impact)

Exterior
 VDS FC-3
 CDC 12FCEW3
 Interior
 VCDI AS0000000
 Maximum Deformation Negligible

Figure 1. Summary of Results - QuadGuard M10 System Test 01-3044-004



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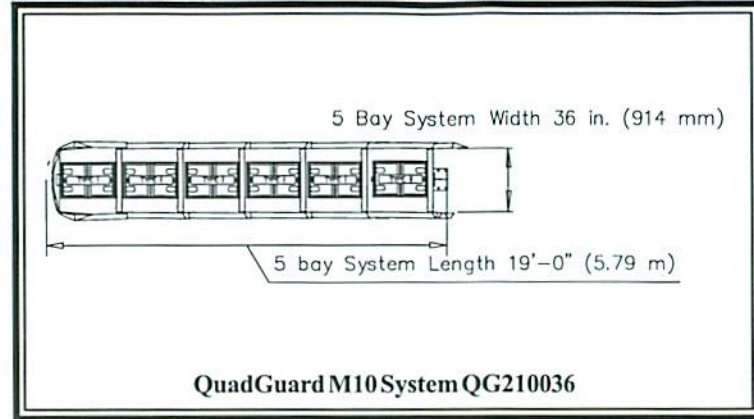
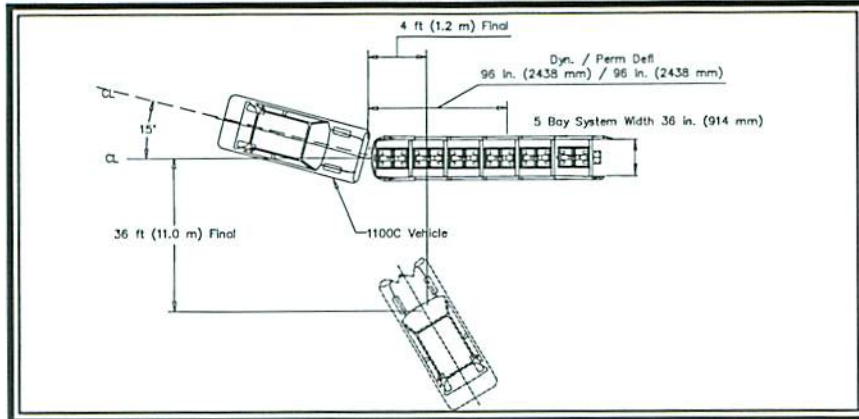
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QuadGuard M10 System QG210036

General Information

Test Agency	E-TECH Testing Services, Inc.
Test Designation	MASH Test 3-32
Test No.	01-3044-003
Date	12/3/09
Test Article	
Type	Energy Absorption System
.....	QuadGuard M10 System QG210036
Installation Length	5 bay 19 ft. (5790 mm) long
.....	36 in. (914) mm wide
Material and key elements	(6) energy absorbing cartridges
.....	(3) Type M-I and (3) Type M-II
.....	AASHTO M180 Quad Panels
.....	ASTM A36 other, galvanized
.....	steel construction
Foundation Type and Condition	Unreinforced 27.6 Mpa concrete,
.....	clean and dry, with (46) 19 mm x
.....	178 mm ASTM A193 Grade B-7
.....	threaded studs and
.....	MP-3 Anchoring System
Test Vehicle	
Type	Production Model
Designation	1100C
Model	2003 Kia Rio 4 Door Sedan
Mass	
Curb	2310 lb (1048 kg)
Test inertial	2388 lb (1083 kg)
Dummy	165 lb (75 kg)
Gross Static	2553 lb (1158 kg)

Impact Conditions

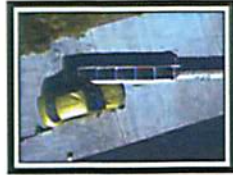
Speed	60.3 mi/h (97.0 km/h)
Angle (deg)	15
Impact Severity	290.0 ft-kip (393.2 kJ)
Exit conditions	
Speed	N/A
Angle (deg - veh. c.g.)	N/A
Occupant Risk Values	
Impact Velocity	
x-direction	36.5 ft/s (11.1 m/s)
y-direction	-0.8 ft/s (-0.2 m/s)
Ridedown Acceleration (g's)	
x-direction	-17.8
y-direction	-4.2
European Committee for Normalization (EN) Values	
THIV	25.1 mi/h (40.4 km/h)
PHD (g's)	17.8
ASI	1.3
Post-Impact Vehicular Behavior (deg - rate gyro)	
Maximum Roll Angle	-9.0
Maximum Pitch Angle	-8.6
Maximum Yaw Angle	-113.4
Test Article Deflections	
Dynamic	96 in. (2438 mm)
Permanent	96 in. (2438 mm)
Vehicle Damage (Primary Impact)	
Exterior	
VDS	FC-3
CDC	12FCEW3
Interior	
VCDI	AS0000000
Maximum Deformation	Negligible



Figure 6. Summary of Results - QuadGuard M10 System Test 01-3044-003



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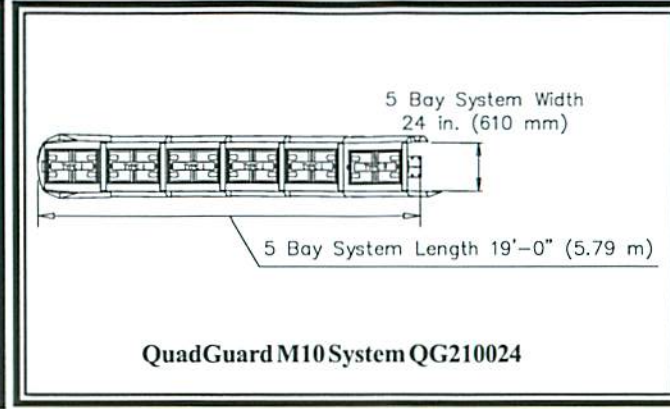
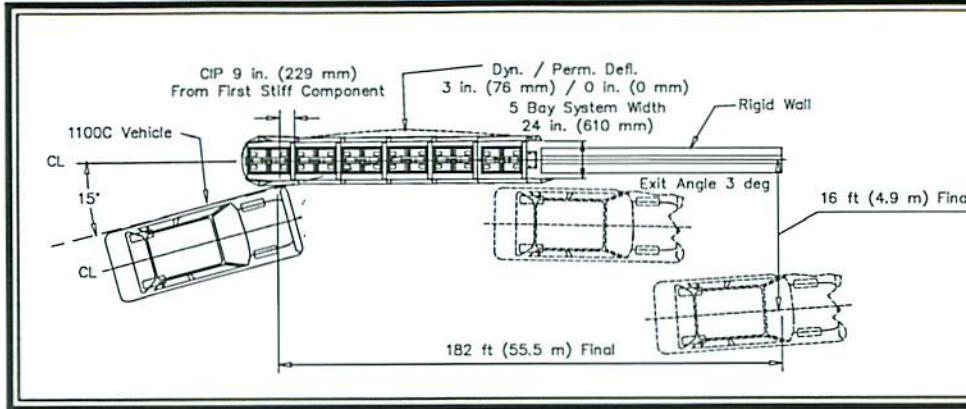
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E-TECH Testing Services, Inc.

QuadGuard® M10 Crash Test Results - 29 of 86

General Information

Test Agency	E-TECH Testing Services, Inc.
Test Designation	MASH Test 3-34
Test No.	01-3044-001
Date	8/4/06
Test Article	
Type	Energy Absorption System
.....	QuadGuard M10 System QG210036
Installation Length	5 bay 19 ft. (5790 mm) long
.....	24 in. (610 mm) wide
Material and key elements	(6) energy absorbing cartridges
.....	(3) Type M-I and (3) Type M-II
.....	AASHTO M180 Quad Panels
.....	ASTM A36 other, galvanized
.....	steel construction
Foundation Type and Condition	Unreinforced 27.6 Mpa concrete,
.....	clean and dry, with (46) 19 mm x
.....	178 mm ASTM A193 Grade B-7
.....	threaded studs and
.....	MP-3 Anchoring System
Test Vehicle	
Type	Production Model
Designation	1100C
Model	2003 Kia Rio 4 Door Sedan
Mass	
Curb	2292 lb (1040 kg)
Test inertial	2372 lb (1076 kg)
Dummy	165 lb (75 kg)
Gross Static	2537 lb (1151 kg)

Impact Conditions

Speed	63.7 mi/h (102.5 km/h)
Angle (deg)	15
Impact Severity	21.5 ft-kip (29.2 kJ)
Exit conditions	
Speed	60.4 mi/h (97.2 km/h)
Angle (deg - veh. c.g.)	3
Occupant Risk Values	
Impact Velocity	
x-direction	19.1 ft/s (5.8 m/s)
y-direction	21.3 ft/s (6.5 m/s)
Ridgedown Acceleration (g's)	
x-direction	-10.6
y-direction	8.9
European Committee for Normalization (EN) Values	
THIV	18.4 mi/h (29.6 km/h)
PHD (g's)	10.9
ASI	1.5
Post-Impact Vehicular Behavior (deg - rate gyro)	
Maximum Roll Angle	-13.2
Maximum Pitch Angle	31.6
Maximum Yaw Angle	34.6
Test Article Deflections	
Dynamic	3 in. (76 mm)
Permanent	0 in. (0 mm)
Vehicle Damage (Primary Impact)	
Exterior	
VDS	FLQ-4
CDC	11FLEW2
Interior	
VCDI	LF1020000
Maximum Deformation	3.3 in. (85 mm)

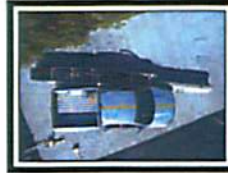
Figure 11. Summary of Results - QuadGuard M10 System Test 01-3044-001



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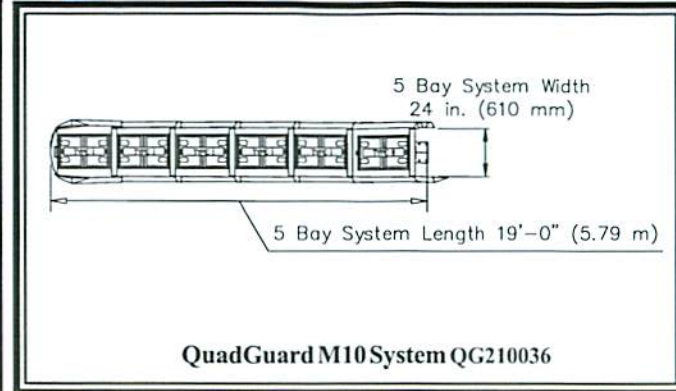
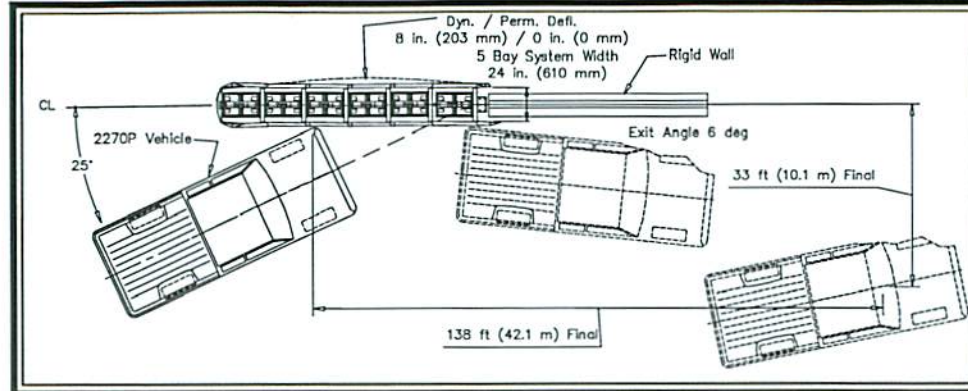
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t = 0.350 sec



E-TECH Testing Services, Inc.

QuadGuard® M10 Crash Test Results - 35 of 86

General Information

Test Agency E-TECH Testing Services, Inc.
 Test Designation MASH Test 3-36
 Test No. 01-3044-002
 Date 8/23/06

Test Article

Type Energy Absorption System
 QuadGuard M10 System QG210024
 Installation Length 5 bay 19 ft. (5790 mm) long
 24 in. (610 mm) wide
 Material and key elements (6) energy absorbing cartridges
 (3) Type M-I and (3) Type M-II
 AASHTO M180 Quad Panels
 ASTM A36 other, galvanized
 steel construction
 Foundation Type and Condition Unreinforced 27.6 Mpa concrete,
 clean and dry, with (46) 19 mm x
 178 mm ASTM A193 Grade B-7
 threaded studs and
 MP-3 Anchoring System

Test Vehicle

Type Production Model
 Designation 2270P
 Model 2002 Dodge 1500 Quadcab Pickup
 Mass
 Curb 4885 lb (2216 kg)
 Test inertial 4918 lb (2231 kg)
 Dummy N/A
 Gross Static 4918 lb (2231 kg)

Impact Conditions

Speed 61.5 mi/h (99.0 km/h)
 Angle (deg) 25
 Impact Severity 111.1 ft-kip (150.6 kJ)
 Exit conditions
 Speed 45 mi/h (72 km/h)
 Angle (deg - veh. c.g.) 6

Occupant Risk Values

Impact Velocity
 x-direction 17.9 ft/s (5.4 m/s)
 y-direction 24.3 ft/s (7.4 m/s)
 Ridedown Acceleration (g's)
 x-direction -6.9
 y-direction 14.2

European Committee for Normalization (EN) Values

THIV 20.6 mi/h (33.2 km/h)
 PHD (g's) 14.3
 ASI 1.5

Post-Impact Vehicular Behavior (deg - rate gyro)

Maximum Roll Angle -24.2
 Maximum Pitch Angle 22.3
 Maximum Yaw Angle 44.3

Test Article Deflections

Dynamic 8 in. (203 mm)
 Permanent 0 in. (0 mm)

Vehicle Damage (Primary Impact)

Exterior
 VDS FLQ-4
 CDC 11LFEW2
 Interior
 VCDI FS1110000
 Maximum Deformation 4.3 in. (110 mm)

Figure 16. Summary of Results - QuadGuard M10 System Test 01-3044-002



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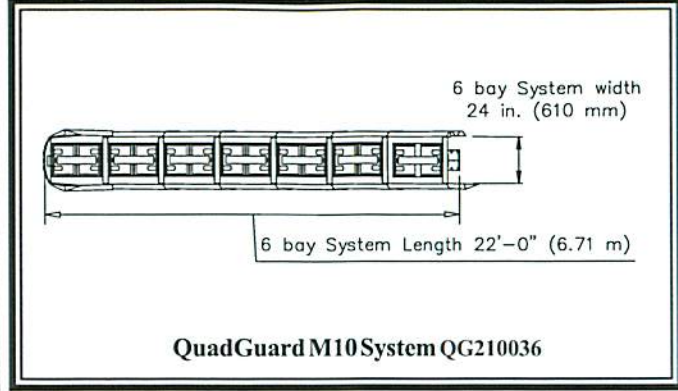
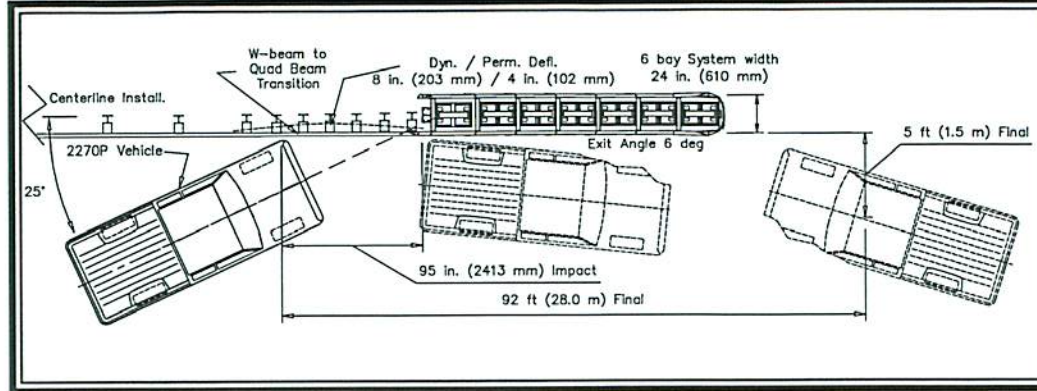
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E-TECH Testing Services, Inc



QuadGuard M10 System QG210036

General Information

Test Agency E-TECH Testing Services, Inc.
 Test Designation MASH Test 3-37
 Test No. 01-3044-005
 Date 4/1/10

Test Article

Type Energy Absorption System
 QuadGuard M10 System QG210024
 w/ w-beam to quad beam transition
 Installation Length 6 bay 22 ft. (6710 mm) long
 24 in. (610 mm) wide
 Material and key elements (7) energy absorbing cartridges
 (4) Type M-I and (3) Type M-II
 AASHTO M180 Quad Panels
 ASTM A36 other, galvanized
 steel construction
 Foundation Type and Condition QuadGuard: Unreinforced 44000 psi
 (27.6 Mpa) concrete, clean and dry,
 with (46) 19 mm x 178 mm ASTM A193
 Grade B-7 threaded studs and
 MP-3 Anchoring System
 Transition: Standard soil AASHTO
 M147 static performance >90%
 standard post installation

Test Vehicle

Type Production Model
 Designation 2270P
 Model 2004 Dodge 1500 Quadcab Pickup
 Mass
 Curb 4777 lb (2267 kg)
 Test inertial 5004 lb (2270 kg)
 Dummy N/A
 Gross Static 5004 lb (2270 kg)

Impact Conditions

Speed 62.0 mi/h (99.7 km/h)
 Angle (deg) 25
 Impact Severity 114.6 ft-kip (155.4 kJ)
 Exit conditions
 Speed 29mi/h (47 km/h)
 Angle (deg - veh. c.g.) 6

Occupant Risk Values

Impact Velocity
 x-direction 25.6 ft/s (7.8 m/s)
 y-direction 25.6 ft/s (7.8 m/s)
 Ridedown Acceleration (g's)
 x-direction -13.7
 y-direction 8.6

European Committee for Normalization (EN) Values

THIV 24.2 mi/h (38.9 km/h)
 PHD (g's) 14.9
 ASI 1.5

Post-Impact Vehicular Behavior (deg - rate gyro)

Maximum Roll Angle -21.8
 Maximum Pitch Angle -15.4
 Maximum Yaw Angle -115.1

Test Article Deflections

Dynamic 8 in. (203 mm)
 Permanent 4 in. (102 mm)





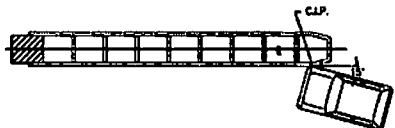
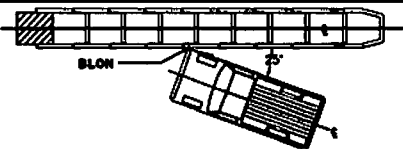
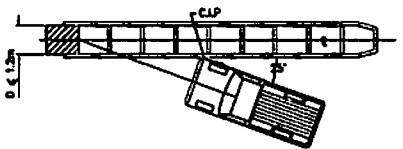
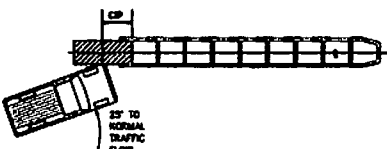

Vehicle Damage (Primary Impact)

Exterior
 VDS FLQ-4
 CDC 11LFEW3
 Interior
 VCDI FS1110000
 Maximum Deformation 4.7 in. (120 mm)

QuadGuard® M10 Crash Test Results - 41 of 86

Figure 21. Summary of Results - QuadGuard M10 System Test 01-3044-005

Table 2.
MASH TEST MATRIX
TERMINALS AND CRASH CUSHIONS
REDIRECTIVE NONGATING
FOR TL-3
(QuadGuard M10)

Illustration	Test #	Completed	Notes
	3-30	NO	Test 3-32 was completed as "Worst Case" for 1100C.
	3-31	YES	Passed all ORV's. 6-Bay 610 mm [24 inches] Narrow System was tested and passed all Occupant Risk Values.
	3-32	YES	Passed all ORV's. 5-Bay 914 mm [36 inches] Narrow System was tested.
	3-33	NO	Test 3-31 tested system capacity for 2270P and is considered worst case.
	3-34	YES	Passed all ORV's. 5-Bay 610 mm [24 inches] Narrow System was tested.
	3-35	NO	Due to the lateral stiffness of the QuadGuard M10, this test is the same as test 3-36 and can be waived.
	3-36	YES	Passed all ORV's. 5-Bay 610 mm [24 inches] Narrow System with no new nose brackets was tested.
	3-37	YES	Passed all ORV's. 6-Bay 610 mm [24 inches] Narrow System attached to a w-beam transition.
	3-38	YES	The recommended MASH analysis was completed and all calculated ORV's passed.

Test Matrix Summary:

Although the QG is a family of systems in various widths and lengths, at this time, only the most popular 6-bay QG M10 in various widths was tested. Tests were chosen to be the worst case tests which demonstrated the performance of the system over various widths.

Notes:

- 1) Narrow systems have backup widths of 610 mm [24 inches], 762 mm[30 inches], and 914 mm [36 inches].
- 2) Wide systems have backup widths of 1755 mm [69 inches] and 2285 mm [90 inches].

Completed Tests:

Tests 3-31 (2270P/ 100kph/ 0°) was conducted on the 6-bay narrow (610 mm [24 inch] width) system. This test demonstrated the capacity of the narrow 6 bay system at the TL-3 level. The minimum width QG system was chosen for this test, because it is considered the worst case as it minimizes momentum transfer.

Tests 3-32 (1100C/ 100kph/ 15° into nose) was conducted on the 6-bay narrow (914 mm [36 inch] width) system. This test also demonstrated the performance of the narrow 6 bay system at the TL-3 level. This width system was chosen to maximize the potential for high delta-Vs, while also testing the capacity of the system for vehicles of this size.

Tests 3-34 (1100C/ 100kph/ 15° @B.L.O.N) was conducted on a standard 5-bay QG II. Although this system was shorter than the final system design and it did not have the improvements to the nose compartment hardware, the nose hardware and length do not significantly affect the ability of the system to redirect a vehicle during this test condition. In fact, the shorter length system can be judged to be “worst-case”, as it shortens the duration of vehicle contact with the QG and maximizes the snag potential at the downstream end of the system.

Tests 3-36 (2270P/ 100kph/ 25° @ C.I.P.) was conducted on a standard 5-bay QG II. Although this system was shorter than the final system design and it did not have the improvements to the nose compartment hardware, the nose hardware and length do not significantly affect the ability of the system to redirect a vehicle during this test condition. In fact, the shorter length system can be judged to be “worst-case”, as it shortens the duration of vehicle contact with the QG and maximizes the snag potential at the downstream end of the system.

Test 3-37 (2270P/ 100kph/ 25° C.I.P. Transition wrong-way) was conducted on the 6-bay narrow (610 mm [24 inch] width) system attached to a w-beam transition. The w-beam guardrail transition, shown in figure 4, is considered the “worst case” test condition of the six transition designs that are included with this submittal. The six transitions are:

1. Transition to w-beam
2. Transition to thrie-beam
3. 4” offset transition to CMB
4. 9” offset transition to CMB (No wide system version)
5. Transition to vertical wall
6. 6” offset transition to single slope barrier

Changes for the QuadGuard M10 system:

As discussed above, changes were made to the QG II system to create the QG M10 system. An illustration of the 914 mm [36 inch] backup QG M10 system tested is shown below in figure 2b. A similar 610 [24 inch] backup QG M10 system was also tested. Figure 2a shows a 2286 mm [90 inch] QG M10 system for comparison.

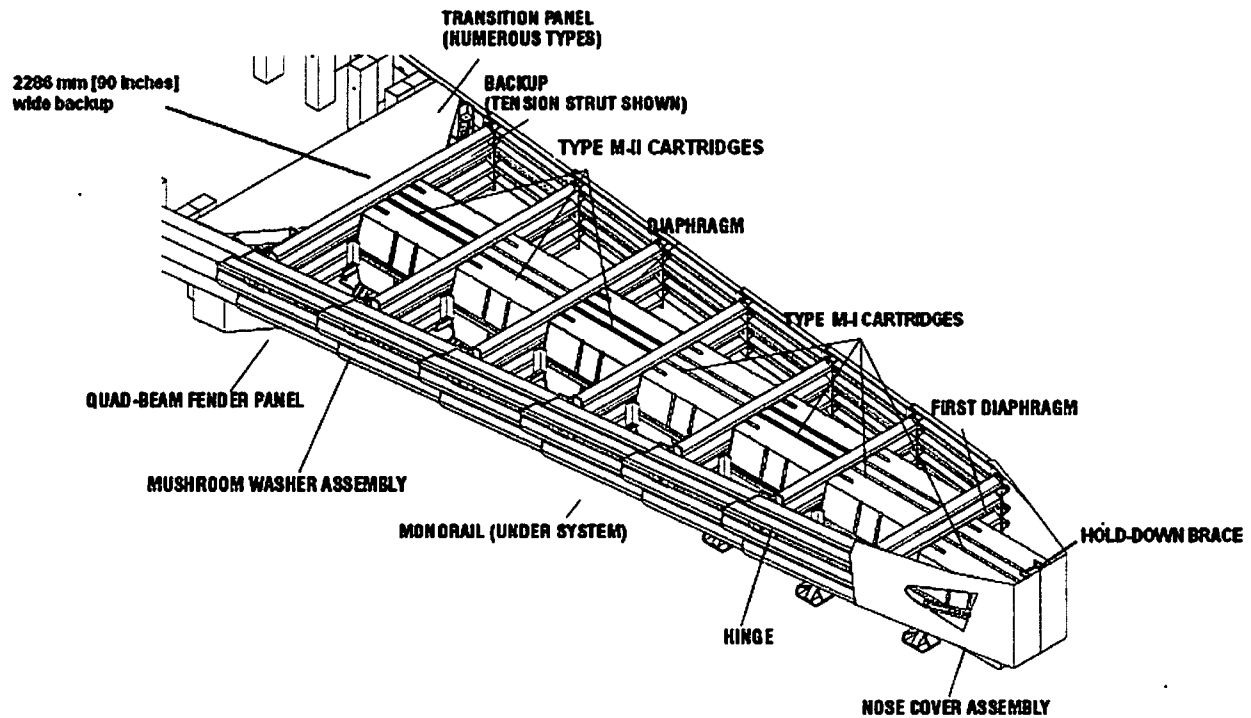


Fig 2a. QuadGuard® M10 Wide System 2286 mm [90 inches]

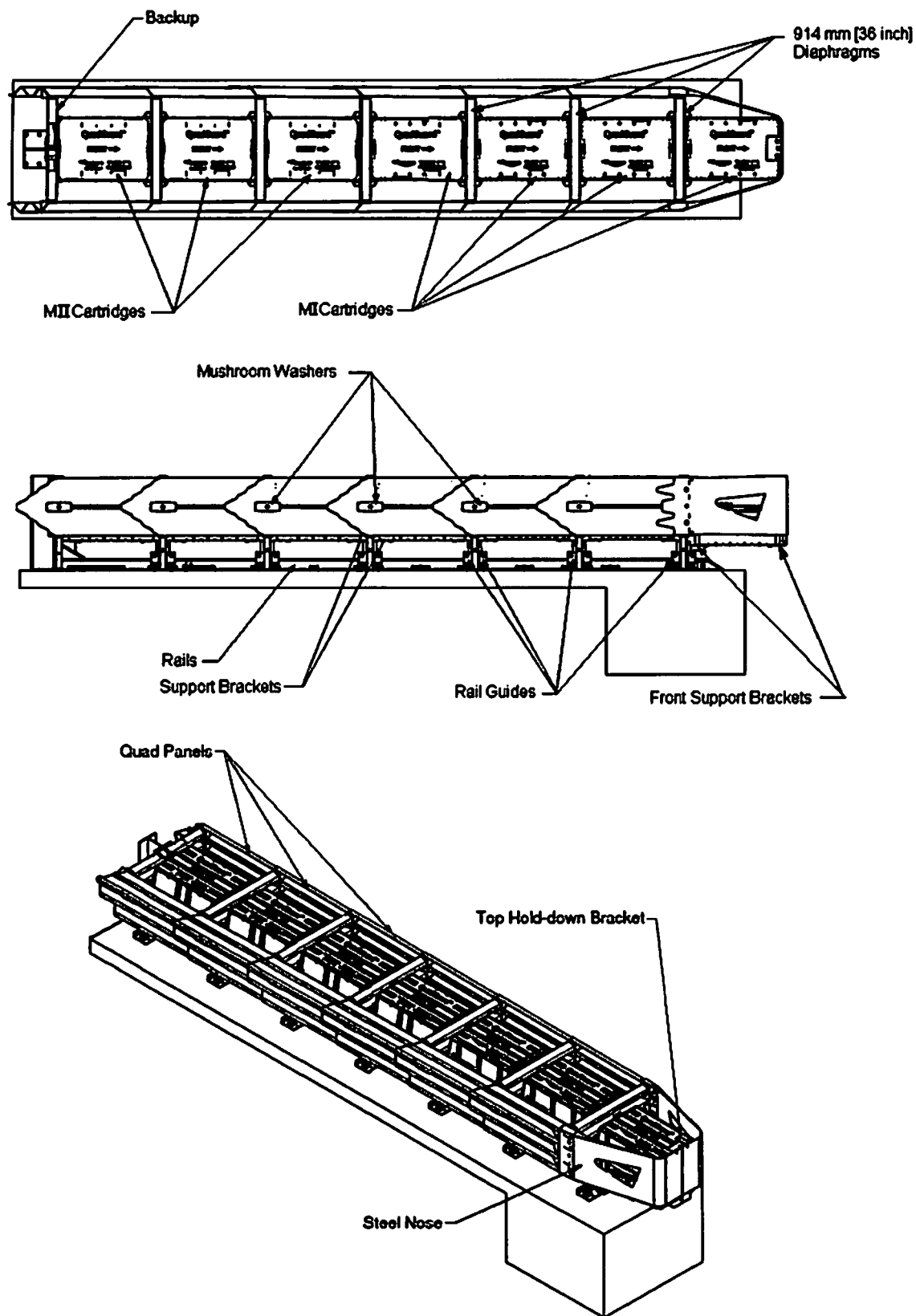
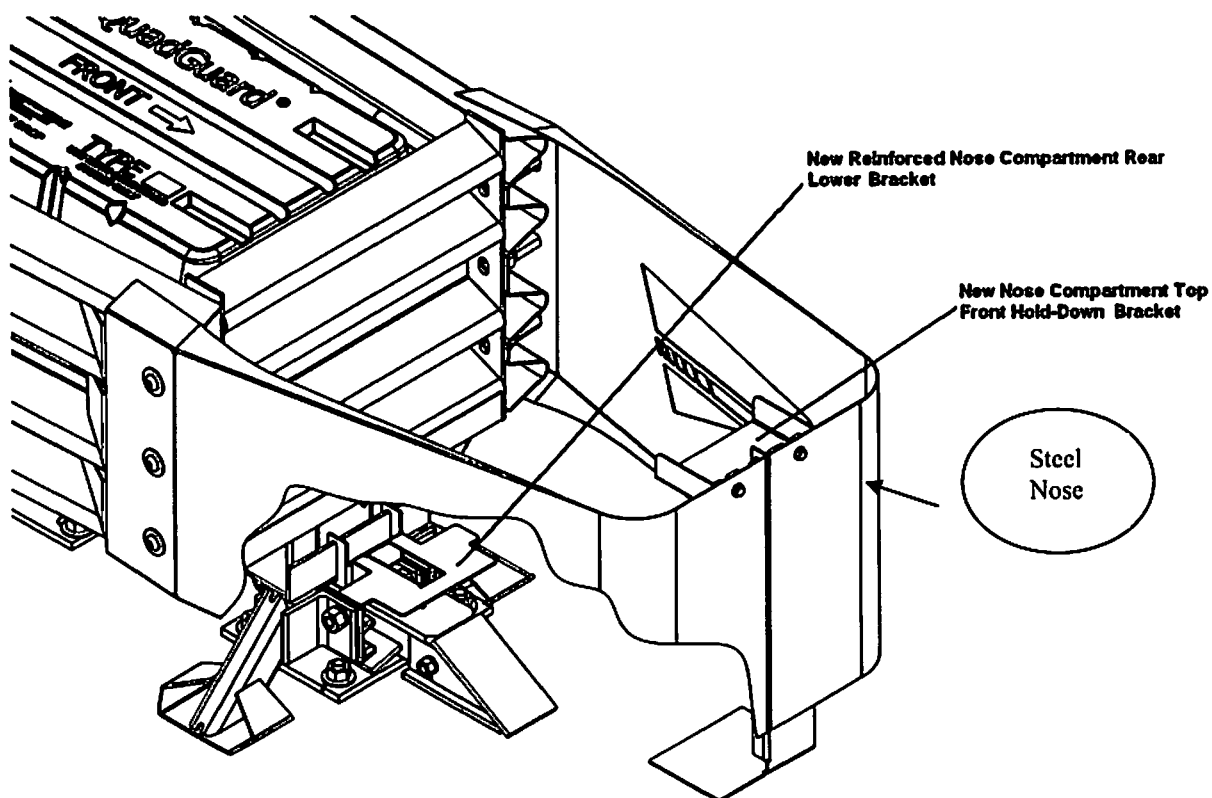


Fig. 2b. 6-Bay QuadGuard® M10 Narrow System 914 mm [36 inches] Tested to MASH TL-3.

Changes incorporated in the QG M10 are as follows:

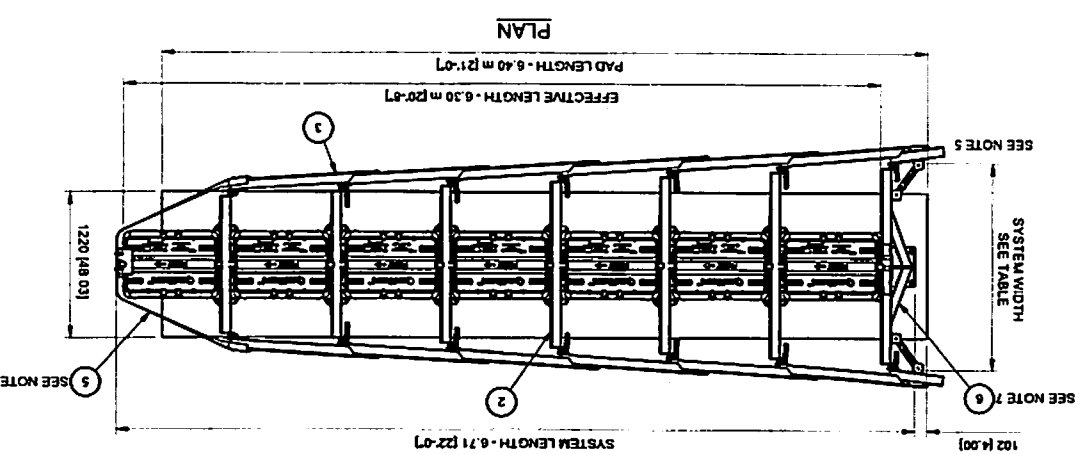
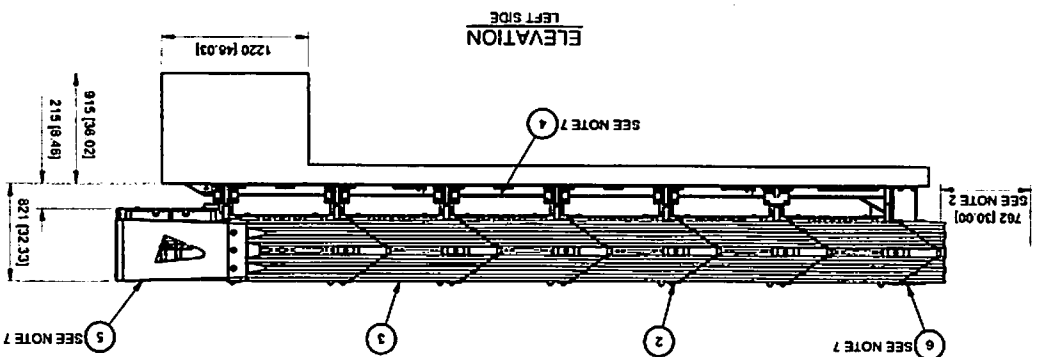
1. One additional bay per system: A “bay” consists of one repeated section of the system and includes; two fender panels (sides), a cartridge (center) and a diaphragm (divider). A 6-bay QG II style system has been tested to meet the higher energy requirements of the MASH testing standard. This improvement was tested at the TL-3 requirements as specified by MASH.
2. Use of a reinforced bottom and top bracket: A reinforced rear lower bracket replaced the original bracket and a new upper hold down bracket was added as shown in figure 3 (The cartridge was removed for clarity).
3. Type M-I and M-II cartridges replace the Type I and Type II cartridges respectively. The cartridges were modified as necessary to absorb the extra energy of the larger MASH test vehicles.



**Fig.3. QuadGuard® M10 Steel Nose Compartment with new Brackets
(The front cartridge is removed to show detail)**

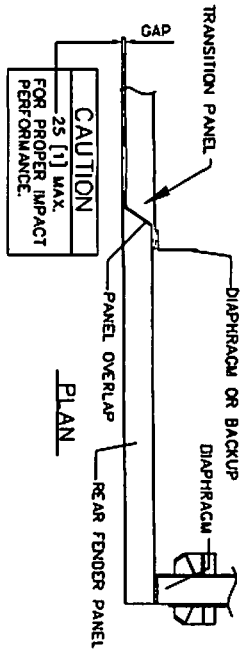
Revision		Date	Rev	By	Chk	App
KEY ① CARTRIDGE ② DIAPHRAGM ③ FENDER PANEL ④ MONORAIL ⑤ NOSE ASSEMBLY ⑥ BACKUP						
SERIAL NO.	SHIM KIT, DIAPHRAGM DIAPHRAGM ASSY.					
SALES ORDER	NOSE ASSY. FENDER PANEL ASSY. BACKUP ASSY. MONORAIL ASSY.					
EH PROJECT	CONCRETE PAD NO. OF UNITS					
REFERENCES 3540340-0000 D. Standridge 4/2/2010 3540078-0000 S. Thompson 12/15/2008 617388 35-40-04 3540380-0000 35-40-75 35-40-78						
QFMTCVR-U-BW QFMTCVR-U 1 of 1						
QUADGUARD M10 SYSTEM WDE SYSTEM WITH TENSION STRUT BACKUP						
ENERGY ABSORPTION SYSTEMS INC ENGINEERING AND RESEARCH DEPARTMENT						

BAYS	1753 [897 WIDTH]	2266 [807 WIDTH]	MAX DESIGN SPEED	NO. OF CARTRIDGES
MODEL #	QM10569	QM10590	KPH	TYPE M4
MODEL #	--	--	KPH	TYPE M4-I
NO. OF CARTRIDGES	105	105	[85]	3

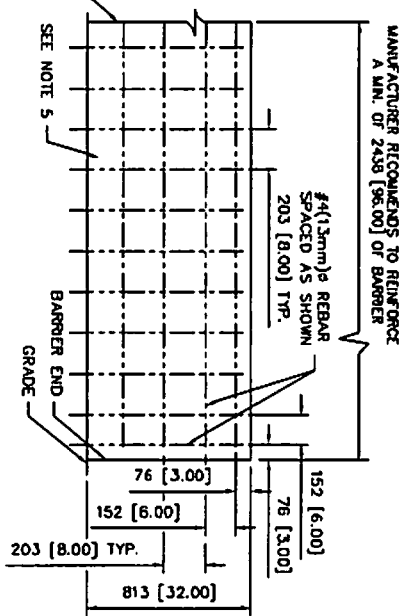


- NOTES:
1. IN COMPLIANCE WITH THE ASHTO 2008 ROADSIDE DESIGN GUIDE, MANUFACTURER RECOMMENDS REMOVAL OF ALL CURBS AND ISLANDS TO ENSURE PROPER IMPACT PERFORMANCE.
 2. PROVISION SHALL BE MADE FOR REAR FENDER PANELS TO SLIDE REARWARD UPON IMPACT 762 (30.00) MIN.
 3. 150 (6.00) MIN, REINFORCED 28 MPa (4000 PSI) P.C. CONCRETE PAD OR 200 (8.00) MIN NON-REINFORCED 28 MPa (4000 PSI) P.C. CONCRETE ROADWAY, MEASURING AT LEAST 3.66 m (12'-07) WIDE BY 15.24 m (50'-07) LONG.
 4. SEE THE QUADGUARD M10 SYSTEM PRODUCT MANUAL 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 (888) 323-8374.
 5. WHERE NECESSARY, THE CUSTOMER SHALL SUPPLY AN ADEQUATE TRANSITION FROM THE QUADGUARD M10 SYSTEM TO THE OBJECT BEING SHIELDED.
 6. UNITS OF MEASUREMENT ARE MILLIMETERS (MM) UNLESS OTHERWISE NOTED.
 7. BACKUP, MONORAIL, AND NOSE ASSEMBLIES ARE NOT INCLUDED IN MODEL NUMBER, ORDER SEPARATELY.
 8. THE QUADGUARD M10 HAS BEEN TESTED TO MASH.
 9. TENSION STRUT SHOWN, ALSO AVAILABLE WITH A CONCRETE BACKUP.

UNIDIRECTIONAL



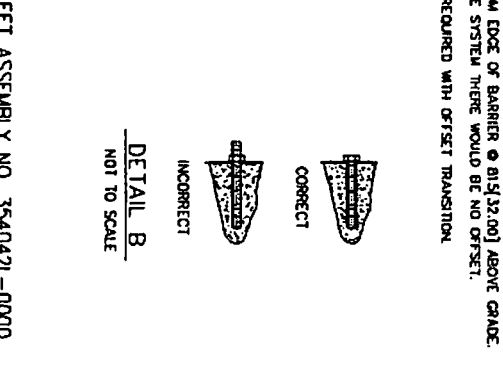
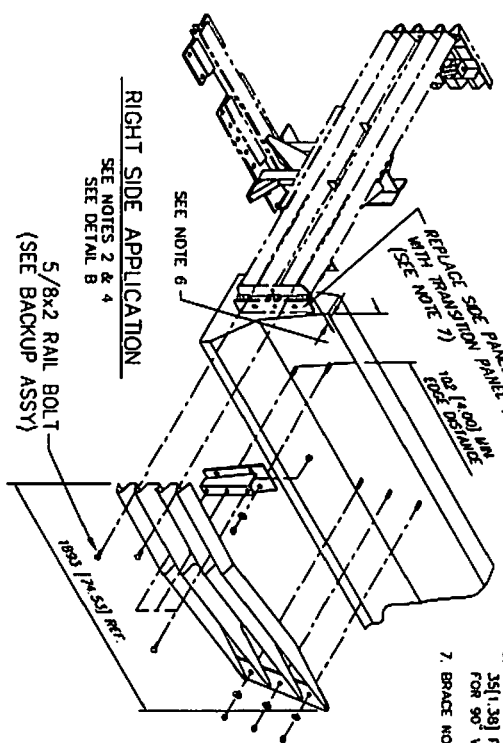
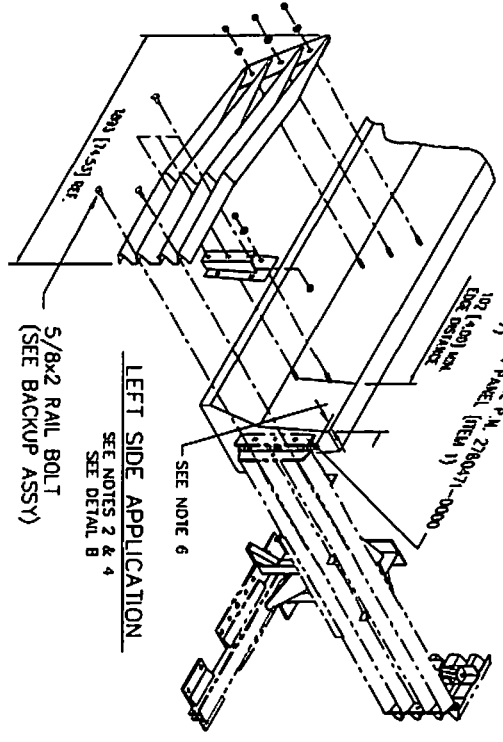
DETAIL A
FREE END REINFORCEMENT
SCALE: 1-24 (SEE NOTES 1 & 3)



MANUFACTURER RECOMMENDS TO REINFORCE
A MIN. OF 2x38 [98.00] OF BARRIER

TABLE - ITEM 1

APPLICATION	PART NO.	DESCRIPTION
LEFT SIDE	2760207-0000	PANEL TRANSITION 4 OFFSET 1.0089/90
RIGHT SIDE	2760280-0000	PANEL TRANSITION 4 OFFSET 1.0089/90



- NOTES:
- THE CONCRETE BARRIER REINFORCEMENT SHOWN IN DETAIL "A" IS RECOMMENDED TO ENSURE ADEQUATE BARRIER INTEGRITY FOR PROPER IMPACT PERFORMANCE. IT IS APPROPRIATE FOR A STANDARD SAFETY SHIELD BARRIER WITH A STD (24.00) BASE AND A 150 [6.00] TOP. VARIATIONS MAY BE REVIEWED AND DETERMINATIONS MADE AS TO REASONABLE EQUIVALENCE BY PROJECT ENGINEER.
 - USE TRANSITION PANEL AS TEMPLATE FOR DRILLING. RECOMMENDED HOLE DEPTH 177 [5.00] FINAL TORQUE TO BE 163nm [120 FT-LBS] (TYP).
 - IMPACT FORCES COULD BE TRANSMITTED INTO TERMINAL END OF THE BARRIER. ADEQUATE ANCHORAGE IS REQUIRED FOR PROPER IMPACT PERFORMANCE.
 - ANCHOR STUD END SHOULD BE RUSH WITH OUTSIDE SURFACE OF ANCHOR NUT. SEE DETAIL B.
 - MIN. 27.6 WPS (4000 PSI) P.C. CONCRETE MEDIUM BARRIER.
 - BACKUP SIDE PLATE FOR 68" WIDE SYSTEM TO BE OFFSET 351[.38] FROM EDGE OF BARRIER @ 813[32.00] ABOVE GRADE. FOR 90" WIDE SYSTEM THERE WOULD BE NO OFFSET.
 - BRACE NOT REQUIRED WITH OFFSET TRANSITION.

Revisions	Date	Rev.	By	Chd/APP.
RT SIDE PART # WAS 2760288-0000	02/28/00	D	HN/B8	SPT
ADDED PLAN VIEW & REARRANGED	10/09/01	E	DPH	FP/DMD

REFERENCES

Name	Date
J. Espinoza	9/23/97
KRM	09/30/97
SPT	10/01/97
354042.dwg	

LEFT ASSEMBLY NO. 354042L-0000
RIGHT ASSEMBLY NO. 354042R-0000

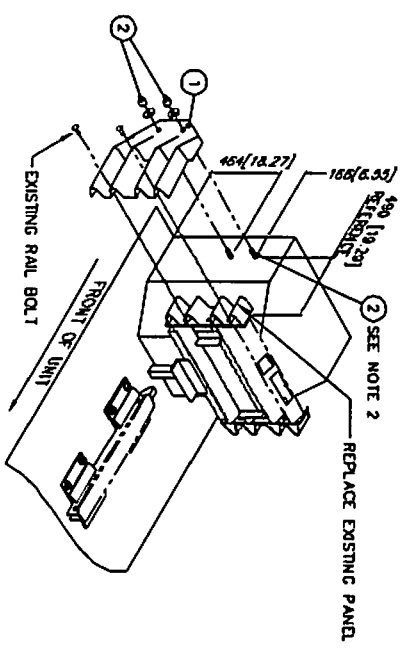
ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

QUADGUARD® SYSTEM
TRANSITION ASSY, 4 OFFSET, 06.69/90

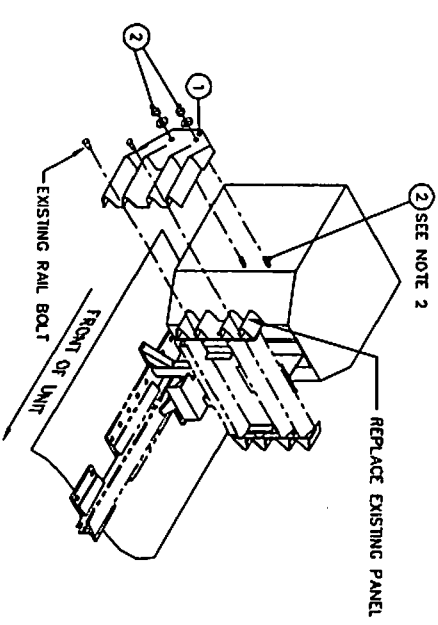
N.T.S. 35-40-42 1 of 1 E

ITEM	STOCK NO.	DESCRIPTION	QTY
1	2760271-0000	SIDE PANEL/END SHOE, Q&G	1.00
2	3528130-0000	ANCHOR/MP-3PT KIT, 3/4X6 1/2 HDR	1.00

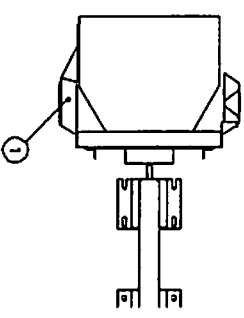
PARTS LIST



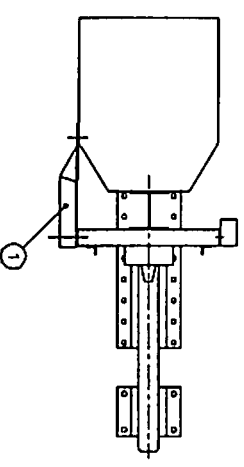
CONCRETE BACKUP



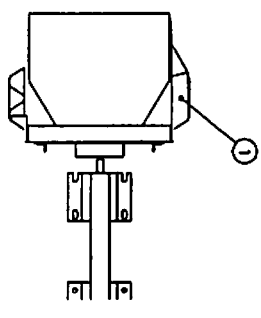
TENSION STRUT BACKUP



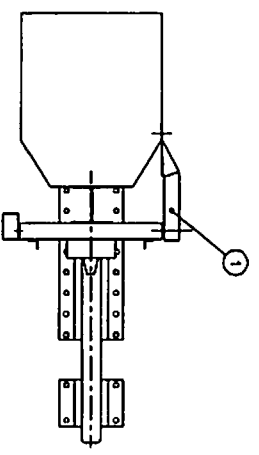
LEFT SIDE APPLICATION



LEFT SIDE APPLICATION



RIGHT SIDE APPLICATION



RIGHT SIDE APPLICATION

NOTES:
 1. DIMENSIONS ARE IN MILLIMETERS (INCHES)
 2. USE END SHOE AS TEMPLATE FOR DRILLING.
 RECOMMENDED HOLE DEPTH 127 [5.00]
 FINAL TORQUE TO BE 163Nm [120 FT.-LBS] (TYP).
 ANCHOR STUD END SHOULD BE FLUSH WITH
 OUTSIDE SURFACE OF ANCHOR NUT.

Revisions	Date	Rev.	By	Chd	App
UPDATED TITLE BLOCK TEXT WAS TL, NOM	09/04/96	C	LMC	KM	SP1
COINTEGRATED DWG 3540270-0000 WITH 35-40-1504/1/96	9/17/96	I	DLS	KM	BB

REFERENCES

Drawn	DATE	Checked	DATE
D. Stouss	5/24/96	WCK	3/1/96
S. Trogeser	6/5/96	W. Krage	6/5/96

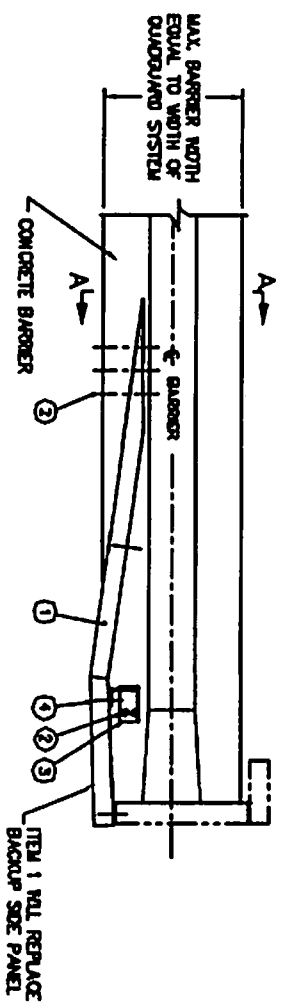
ASSEMBLY NO. 3540150-0000

ENERGY ABSORPTION SYSTEMS, INC.
 ENGINEERING AND RESEARCH DEPARTMENT

QUADGUARD® SYSTEM
 END SHOE ASSY, QG

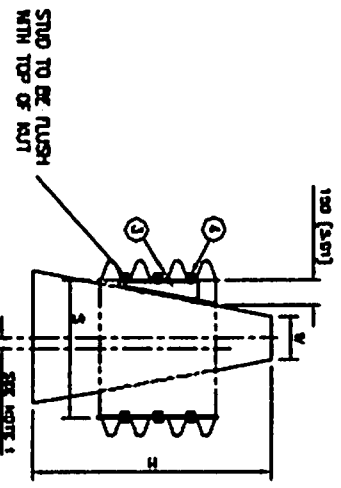
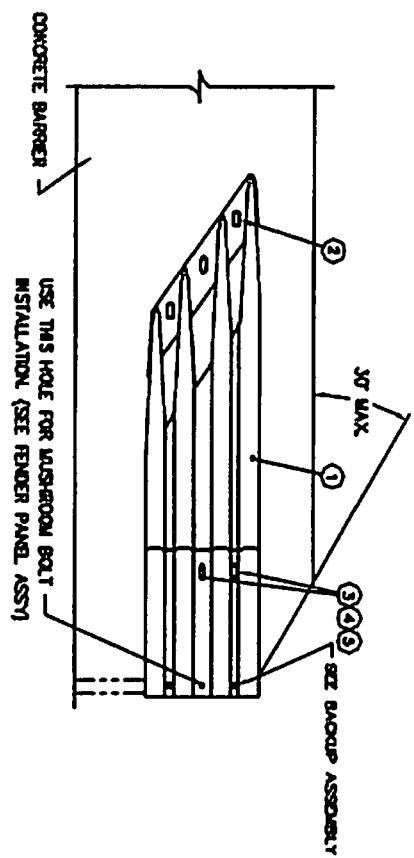
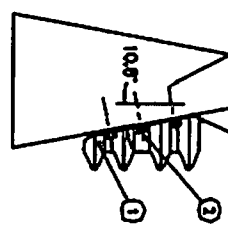
N.T.S. 35-40-15 1 of 1

PARTS LIST			
QTY	STOCK NO.	DESCRIPTION	NOTE
1	2780519-0000	PANEL TRANSITION & OFFSET LUGS	1.00
2	5525130-0000	ANCHOR BOLT 1/2" DIA 1/2" HOR	1.00
3	2780519-0000	ANCHOR SUPPORT FRAM. TO SS	1.00
4	2698341-0000	BOLT GALV 5/8 X 2 1/2	2.00
5	2704181-0000	WRT. HOLES / G.C. PANEL	2.00



BURIEDMENT DEPTH 130 (3.00) MIN.
TORQUE TO 160 Nm (120 FT. LBS.)

END OF PANEL TO BE FLUSH AGAINST BARRIER



NOTE
1. TO DETERMINE THE OFFSET DISTANCE BETWEEN THE CENTERLINE OF THE BARRIER AND THE CENTERLINE OF THE SYSTEM USE ONE OF THE FOLLOWING EQUATIONS: W4.2BH-S-10-OFFSET (mm) W4.02BH-S-02-OFFSET (in).

Revisions	Date	By/Checked	LD	Design	Drawn	Checked	Approved	QC	Tolerance	Material
				O. Stein	6/18/78	GS	AS		d. Anguler d. Liner	
									±	(Unless Otherwise Noted)

REFERENCES

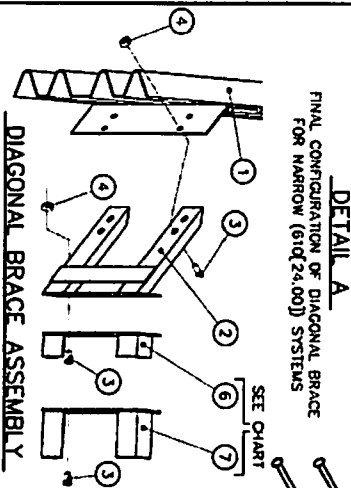
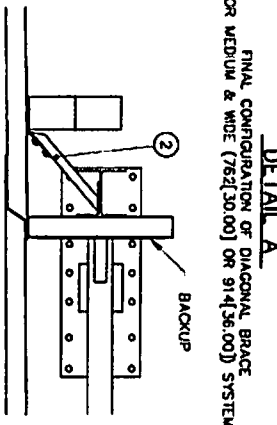
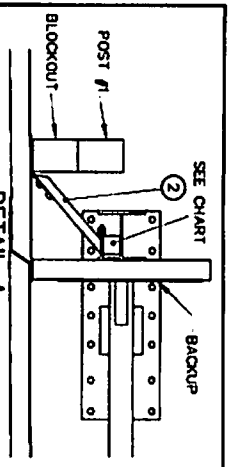
NEXT ASSEMBLY _____

ASSEMBLY NO. 3540475-0000

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

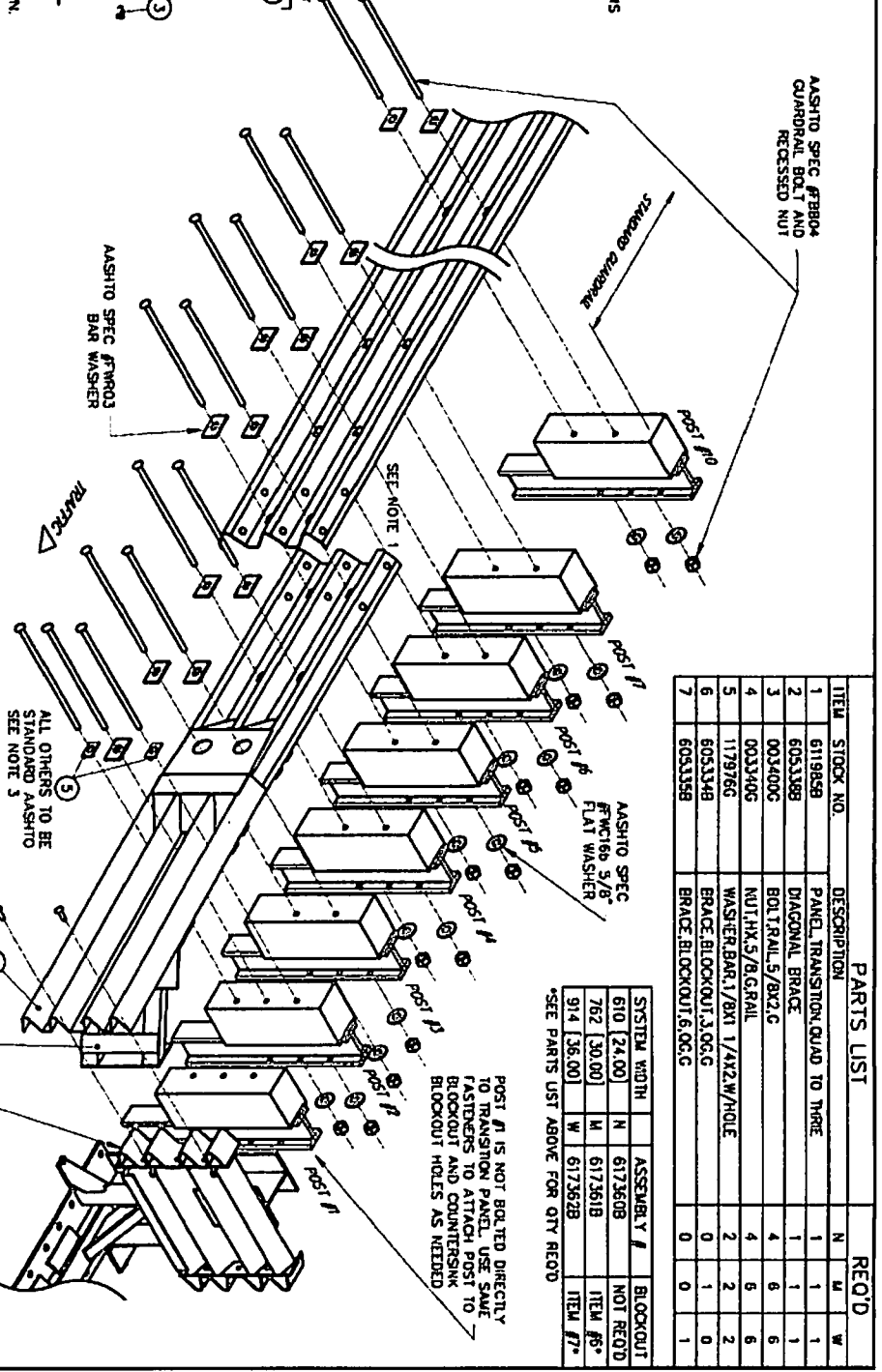
QUADGUARD® SYSTEM
TRANSITION PANEL INSTALLATION
FOR SINGLE SLOPE BARRIER

SCALE	1:16	DATE	3540475-0000	REV	1 of 1
UNIT	1/4"=1'-0"	SEC	C		



NOTES:

1. PANEL OVERLAP SHOWN IS FOR TRAFFIC DIRECTION SHOWN. ACTUAL OVERLAP SHALL BE DETERMINED BY THE SITE CONDITIONS AND PROJECT ENGINEER PER TRAFFIC DIRECTION. USE STANDARD GUARDRAIL CONNECTION.
2. RIGHT SIDE OF ROAD APPLICATION SHOWN. ASSEMBLY MAY BE USED ON EITHER OF BOTH SIDES FOR LEFT, RIGHT, MEDIUM OR CORNER APPLICATIONS. SEE NOTE 1.
3. THIS ASSEMBLY IS NOT INCLUDED IN THE MODEL NUMBER AND MUST BE ORDERED SEPARATELY.
4. ENERGY ABSORPTION SYSTEMS, INC. SUPPLIES THE STOCK ITEMS SHOWN IN THE PARTS LIST. ALL OTHER COMPONENTS OF THE DOWNSTREAM GUARDRAIL ARE STANDARD HIGHWAY MATERIALS AND MAY BE OBTAINED FROM YOUR LOCAL HIGHWAY SUPPLY VENDORS.



ITEM	STOCK NO.	DESCRIPTION	N	M	W
1	611985B	PANEL TRANSITION QUAD TO THREE	1	1	1
2	603338B	DIAGONAL BRACE	1	1	1
3	003400G	BOL T RAIL 5/8X2.G	4	6	6
4	003340G	NUT,HX.5/8.G,RAIL	4	6	6
5	117976G	WASHER,BAR,1/4X1.1/4X2.W/HOLE	2	2	2
6	603334B	BRACE,BLOCKOUT,3.0CG	0	1	0
7	603335B	BRACE,BLOCKOUT,6.0CG	0	0	1

SYSTEM WIDTH	ASSEMBLY #	BLOCKOUT
610 [24.00]	N 617360B	NOT REQ'D
762 [30.00]	M 617361B	ITEM #5*
914 [36.00]	W 617362B	ITEM #7*

*SEE PARTS LIST ABOVE FOR QTY REQ'D

POST #1 IS NOT BOLTED DIRECTLY TO TRANSITION PANEL. USE SAME FASTENERS TO ATTACH POST TO BLOCKOUT AND COUNTERSINK BLOCKOUT HOLES AS NEEDED.

4. TRANSITION AND GUARDRAIL PANEL CONNECTIONS MAY BE SLOTTED IN ORDER TO ACCOMMODATE THERMAL EXPANSION AND CONTRACTION.

5. STEEL POST AND WOOD BLOCKOUTS FOR SYSTEMS THAT MUST MEET WASH.

SEE DIAGONAL BRACE ASSEMBLY & DETAIL A

REPLACE SIDE PANEL TRANSITION PANEL (ITEM 1)

Revisions		Date	Rev.	By	Chd App

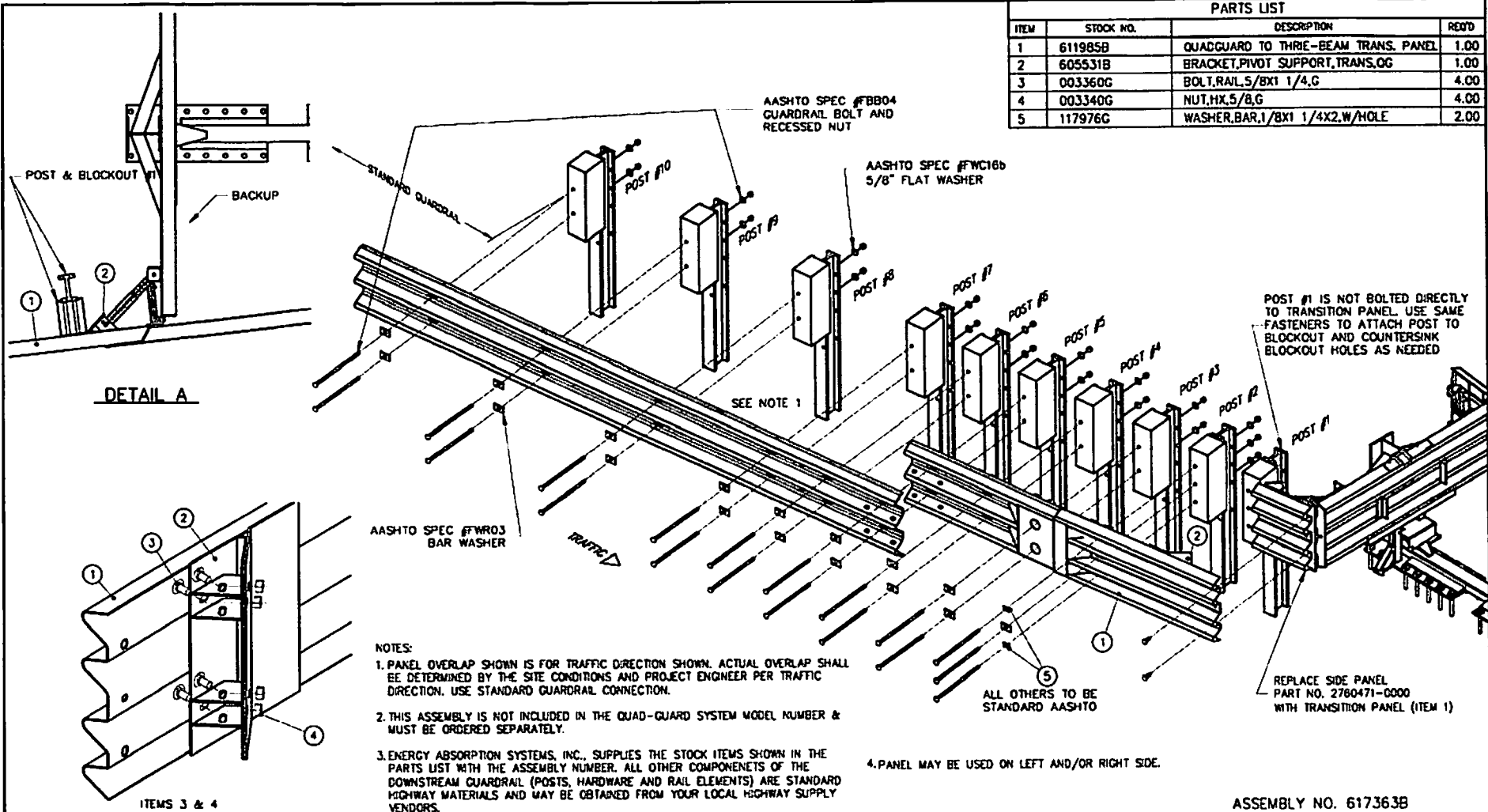
W. Leddington	4/15/10
ST	4/14/10

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

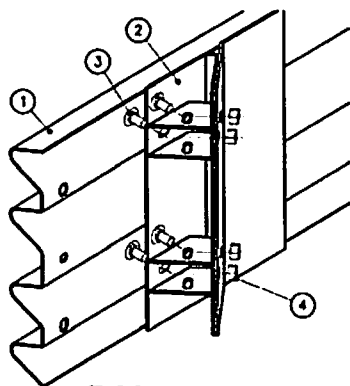
QUADGUARD® M10
TRANSITION ASSEMBLY
QUAD-BEAM TO THREE-BEAM

N.T.S. 617360B 1 of 2

PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	QTY
1	611985B	QUADGUARD TO THREE-BEAM TRANS. PANEL	1.00
2	605531B	BRACKET, PIVOT SUPPORT, TRANS, GG	1.00
3	003360G	BOLT, RAIL, 5/8X1 1/4, G	4.00
4	003340G	NUT, HK, 5/8, G	4.00
5	117976G	WASHER, BAR, 1/8X1 1/4X2, W/HOLE	2.00



DETAIL A



ITEMS 3 & 4
REQUIRED 4 PLACES

ITEM 2 ASSEMBLY

- NOTES:
1. PANEL OVERLAP SHOWN IS FOR TRAFFIC DIRECTION SHOWN. ACTUAL OVERLAP SHALL BE DETERMINED BY THE SITE CONDITIONS AND PROJECT ENGINEER PER TRAFFIC DIRECTION. USE STANDARD GUARDRAIL CONNECTION.
 2. THIS ASSEMBLY IS NOT INCLUDED IN THE QUAD-GUARD SYSTEM MODEL NUMBER & MUST BE ORDERED SEPARATELY.
 3. ENERGY ABSORPTION SYSTEMS, INC., SUPPLIES THE STOCK ITEMS SHOWN IN THE PARTS LIST WITH THE ASSEMBLY NUMBER. ALL OTHER COMPONENTS OF THE DOWNSTREAM GUARDRAIL (POSTS, HARDWARE AND RAIL ELEMENTS) ARE STANDARD HIGHWAY MATERIALS AND MAY BE OBTAINED FROM YOUR LOCAL HIGHWAY SUPPLY VENDORS.

4. PANEL MAY BE USED ON LEFT AND/OR RIGHT SIDE.

REPLACE SIDE PANEL
PART NO. 2760471-0000
WITH TRANSITION PANEL (ITEM 1)

ASSEMBLY NO. 617363B

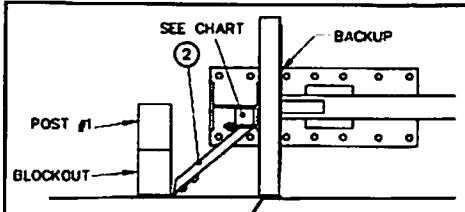
REFERENCES

DESIGNED BY	D. Standridge	DATE	4/20/10
DRAWN BY	S. Thompson	DATE	4/14/10
CHECKED BY			
APPROVED BY			
CAD FILE	617363B.dwg		

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

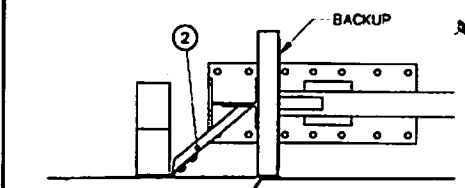
QUADGUARD®
TRANSITION ASSEMBLY,
QUAD-BEAM™ TO THRIE-BEAM - WIDE

Revisions	Date	Rev.	By	Chd.	App.



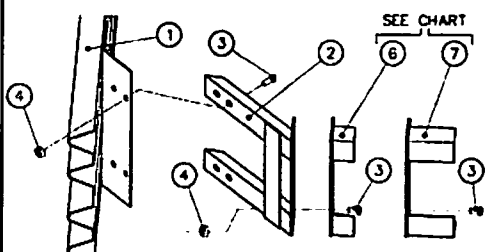
DETAIL A

FINAL CONFIGURATION OF DIAGONAL BRACE FOR MEDIUM & WIDE (762[30.00] OR 914[36.00]) SYSTEMS



DETAIL A

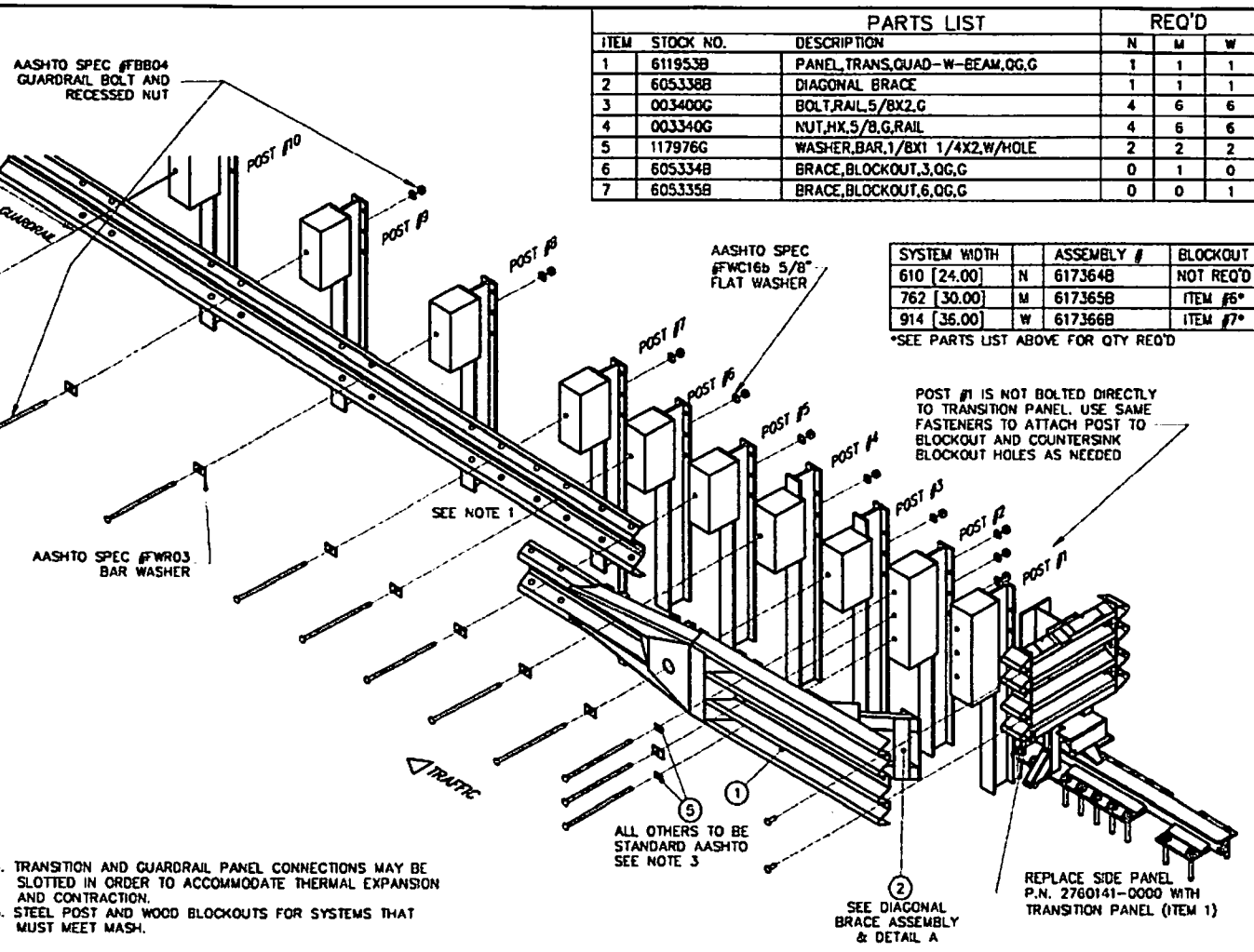
FINAL CONFIGURATION OF DIAGONAL BRACE FOR NARROW (610[24.00]) SYSTEMS



DIAGONAL BRACE ASSEMBLY

- NOTES:**
1. PANEL OVERLAP SHOWN IS FOR TRAFFIC DIRECTION SHOWN. ACTUAL OVERLAP SHALL BE DETERMINED BY THE SITE CONDITIONS AND PROJECT ENGINEER PER TRAFFIC DIRECTION. USE STANDARD GUARDRAIL CONNECTION.
 2. RIGHT SIDE OF ROAD APPLICATION SHOWN. ASSEMBLY MAY BE USED ON EITHER OR BOTH SIDES FOR LEFT, RIGHT, MEDIUM OR CORE APPLICATIONS. SEE NOTE 1. THIS ASSEMBLY IS NOT INCLUDED IN THE MODEL NUMBER AND MUST BE ORDERED SEPARATELY.
 3. ENERGY ABSORPTION SYSTEMS, INC. SUPPLIES THE STOCK ITEMS SHOWN IN THE PARTS LIST. ALL OTHER COMPONENTS OF THE DOWNSTREAM GUARDRAIL ARE STANDARD HIGHWAY MATERIALS AND MAY BE OBTAINED FROM YOUR LOCAL HIGHWAY SUPPLY VENDORS.
 4. TRANSITION AND GUARDRAIL PANEL CONNECTIONS MAY BE SLOTTED IN ORDER TO ACCOMMODATE THERMAL EXPANSION AND CONTRACTION.
 5. STEEL POST AND WOOD BLOCKOUTS FOR SYSTEMS THAT MUST MEET MASH.

Revisions	Date	Rev.	By	Chk.	App.



PARTS LIST				REQ'D		
ITEM	STOCK NO.	DESCRIPTION	N	M	W	
1	611953B	PANEL_TRANS,QUAD-W-BEAM,GG,G	1	1	1	
2	605338B	DIAGONAL BRACE	1	1	1	
3	003400G	BOLT,RAIL,5/8X2,G	4	6	6	
4	003340G	NUT,HX,5/8,G,RAIL	4	6	6	
5	117976G	WASHER,BAR,1/8X1 1/4X2,W/HOLE	2	2	2	
6	605334B	BRACE,BLOCKOUT,3,GG,G	0	1	0	
7	605335B	BRACE,BLOCKOUT,6,GG,G	0	0	1	

SYSTEM WIDTH		ASSEMBLY #	BLOCKOUT
610 [24.00]	N	617364B	NOT REQ'D
762 [30.00]	M	617365B	ITEM #6*
914 [36.00]	W	617366B	ITEM #7*

*SEE PARTS LIST ABOVE FOR QTY REQ'D

POST #1 IS NOT BOLTED DIRECTLY TO TRANSITION PANEL. USE SAME FASTENERS TO ATTACH POST TO BLOCKOUT AND COUNTERSINK BLOCKOUT HOLES AS NEEDED

TRAFFIC

ALL OTHERS TO BE STANDARD AASHTO SEE NOTE 3

SEE DIAGONAL BRACE ASSEMBLY & DETAIL A

REPLACE SIDE PANEL P.N. 2760141-0000 WITH TRANSITION PANEL (ITEM 1)

REFERENCES

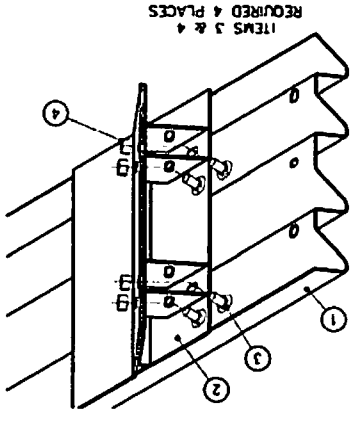
DESIGNED BY	D. Standridge	DATE	4/19/10
DRAWN BY	ST	DATE	4/14/10
CHECKED BY			
APPROVED BY			
CAD FILE	617364B.dwg		
DATE PLOTTED			

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

QUADGUARD® M10
TRANSITION ASSEMBLY
QUAD-BEAM TO W-BEAM

Revisions	Date	Rev. By	Chk App.

ITEM 2 ASSEMBLY



ITEMS 3 & 4
REQUIRED 4 PLACES

1. PANEL OVERLAP SHOWN IS FOR TRAFFIC DIRECTION SHOWN, ACTUAL OVERLAP SHALL BE DETERMINED BY THE SITE CONDITIONS AND PROJECT ENGINEER PER TRAFFIC DIRECTION.
 2. THIS ASSEMBLY IS NOT INCLUDED IN THE QUAD-GUARD SYSTEM MODEL NUMBER & MUST BE ORDERED SEPARATELY.
 3. ENERGY ABSORPTION SYSTEMS, INC., SUPPLIES THE STOCK ITEMS SHOWN IN THE PARTS LIST WITH THE ASSEMBLY NUMBER. ALL OTHER COMPONENTS OF THE DOWNSTREAM GUARDRAIL (POSTS, HARDWARE AND RAIL ELEMENTS) ARE STANDARD HIGHWAY MATERIALS AND MAY BE OBTAINED FROM YOUR LOCAL HIGHWAY SUPPLY VENDORS.
 4. PANEL MAY BE USED ON LEFT AND/OR RIGHT SIDE.

REFERENCES

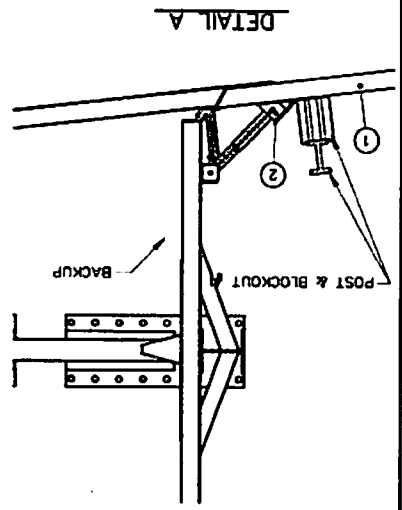
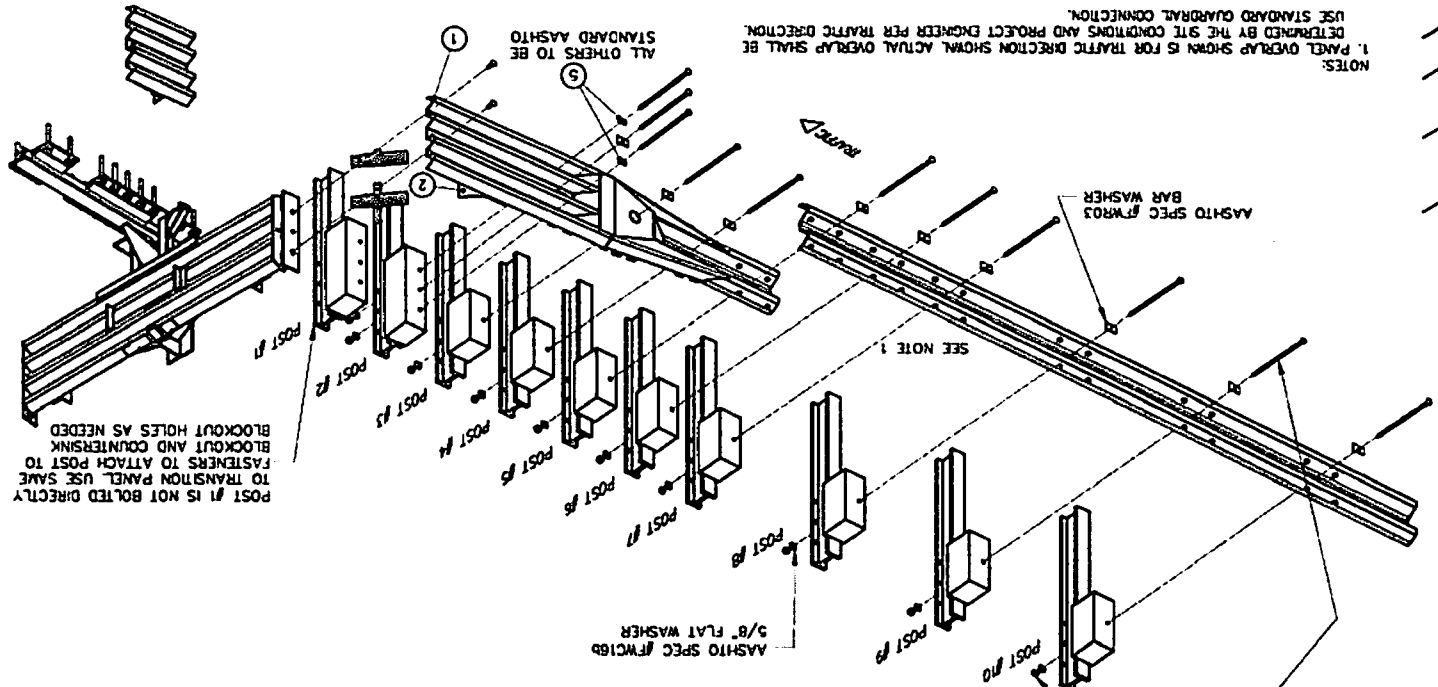
DATE	4/16/10
BY	D. Stenbridge
CHKD BY	S.T.
DATE	4/14/10
FILE	617367.dwg

QUADGUARD® M10
 TRANSITION ASSEMBLY
 QUAD-BEAM™ TO W-BEAM - WIDE

ENERGY ABSORPTION SYSTEMS, INC.
 ENGINEERING AND RESEARCH DEPARTMENT

ASSEMBLY NO. 617367

REPLACE SIDE PANEL
 PART NO. 611908
 WITH TRANSITION PANEL
 (ITEM 1)



POST #1 IS NOT BOLTED DIRECTLY TO TRANSITION PANEL. USE SAME FASTENERS TO ATTACH POST TO BLOCKOUT HOLES AS NEEDED

ASHTO SPEC FBW03 5/8" FLAT WASHER

POST #10

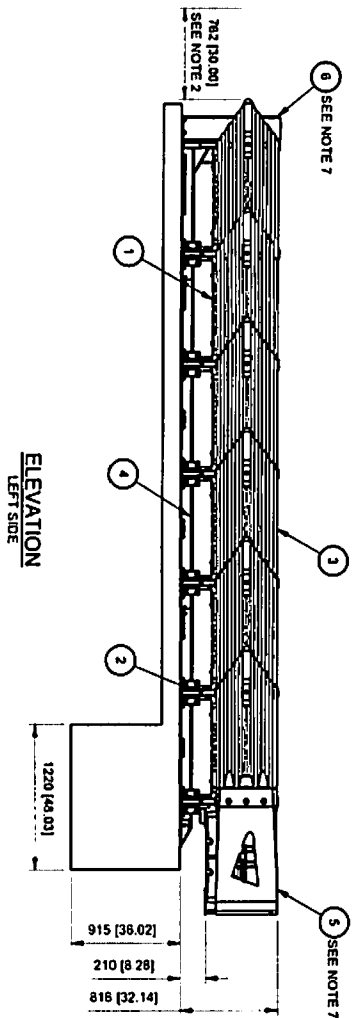
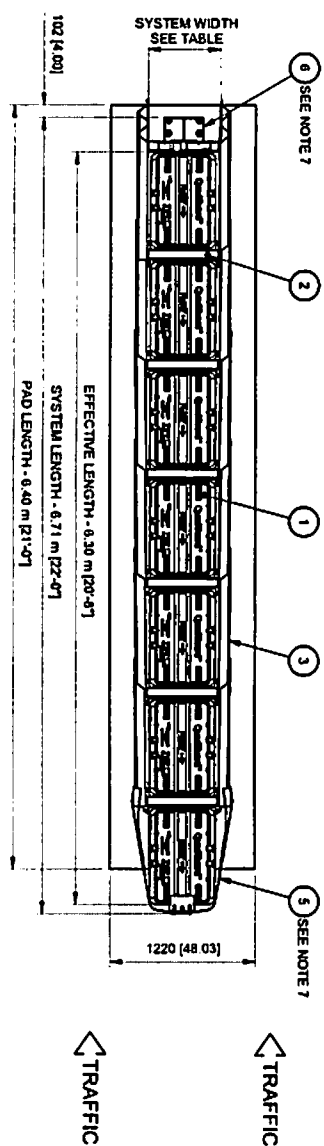
SEE NOTE 1

ASHTO SPEC FBW03 BAR WASHER

ASHTO SPEC FBW04 GUARDRAIL BOLT AND RECESSED NUT

ITEM	STOCK NO.	DESCRIPTION	RECD
1	611953B	PANEL, TRANS, QUAD-W-BEAM, QG.G	1.00
2	605531B	BRACKET, PIVOT SUPPGR, TRANS, QG	1.00
3	003360C	BOLT, RAIL, S/BX1 1/4.G	4.00
4	003340C	NUT, H.K.S/8.G	4.00
5	117976C	WASHER, BAR, 1/4X2.W/HOLE	2.00

PARTS LIST



- NOTES:
1. IN COMPLIANCE WITH THE MASH 2002 ROADSIDE DESIGN GUIDE, MANUFACTURER RECOMMENDS REMOVAL OF ALL CURBS AND ISLANDS TO ENSURE PROPER IMPACT PERFORMANCE.
 2. PROVISION SHALL BE MADE FOR REAR FENDER PANELS TO SLIDE REARWARD UPON IMPACT 762 [250.00] MM.
 3. 150 [6.00] MM, REINFORCED 28 MPa [4000 PSI] P.C. CONCRETE PAD OR 200 [8.00] MM, NON-REINFORCED 28MPa [4000 PSI] P.C. CONCRETE ROADWAY, MEASURING AT LEAST 3.80 m [12'-07"] WIDE BY 13.24 m [50'-07"] LONG.
 4. SEE THE QUADGUARD M10 SYSTEM PRODUCT MANUAL - 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 (800) 323-0374.
 5. WHERE NECESSARY, THE CUSTOMER SHALL SUPPLY AN ADEQUATE TRANSITION FROM THE QUADGUARD M10 SYSTEM TO THE OBJECT BEING SHIELDED.
 6. UNITS OF MEASUREMENT ARE MILLIMETERS (INCHES) UNLESS OTHERWISE NOTED.
 7. BACKUP, MONORAIL, AND NOSE ASSEMBLIES ARE NOT INCLUDED IN MODEL NUMBER, ORDER SEPARATELY.
 8. THE QUADGUARD M10 SYSTEM HAS BEEN TESTED TO WASH.
 9. TENSION STRUT SHOWN, ALSO AVAILABLE WITH CONCRETE BACKUP.

BAYS	610 [247] WIDTH	762 [307] WIDTH	914 [367] WIDTH	MAX DESIGN SPEED	NO. OF CARTRIDGES
6	MODEL # QM10524	MODEL # QM10530	MODEL # QM10536	Km/h [MPH]	TYPE M1
			100 [62]		4
					3

Revision	Date	Rev	By	CHK	APP

KEY	DESCRIPTION
1	CARTRIDGE
2	DIAPHRAGM
3	FENDER PANEL
4	MONORAIL
5	NOSE ASSEMBLY
6	BACKUP

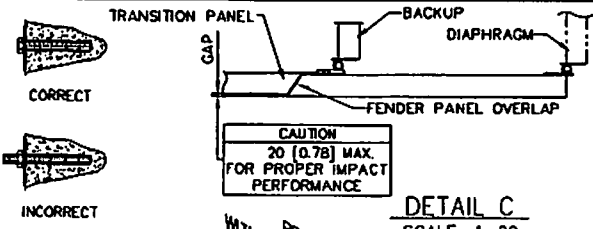
REFERENCES	DESCRIPTION	DATE
35-40-07	DIAPHRAGM ASSY.	4/21/2010
35-40-07-000	SHIM KIT DIAPHRAGM	12/15/2008
617395	NOSE ASSY.	
35-40-04	FENDER PANEL ASSY.	
35-40-75	BACKUP ASSY.	
35-40-78	MONORAIL ASSY.	
	CONCRETE PAD	

UNIDIRECTIONAL

ENERGY ABSORPTION SYSTEMS, INC.
 10000 WILSON ROAD, SUITE 100
 FORT WORTH, TEXAS 76116

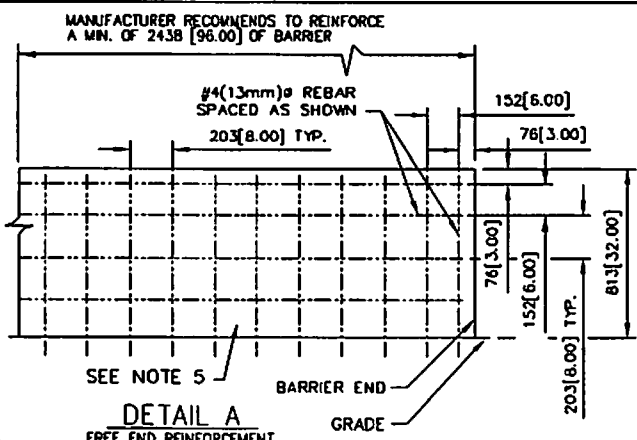
QUADGUARD M10 SYSTEM
 NARROW SYSTEM WITH TENSION STRUT BACKUP

QUATSCVR-U3 1 of 1



DETAIL B
NOT TO SCALE

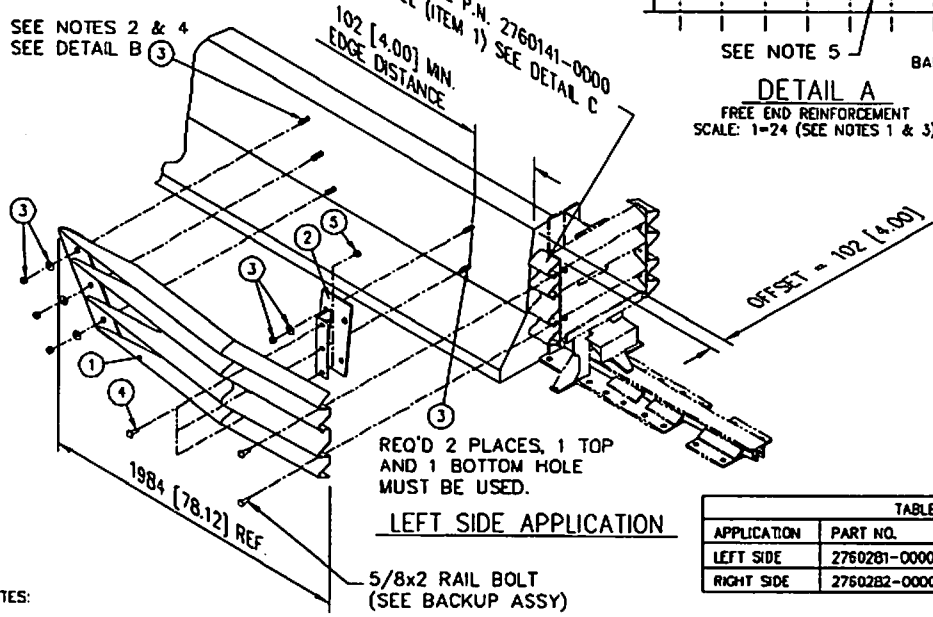
DETAIL C
SCALE: 1=20



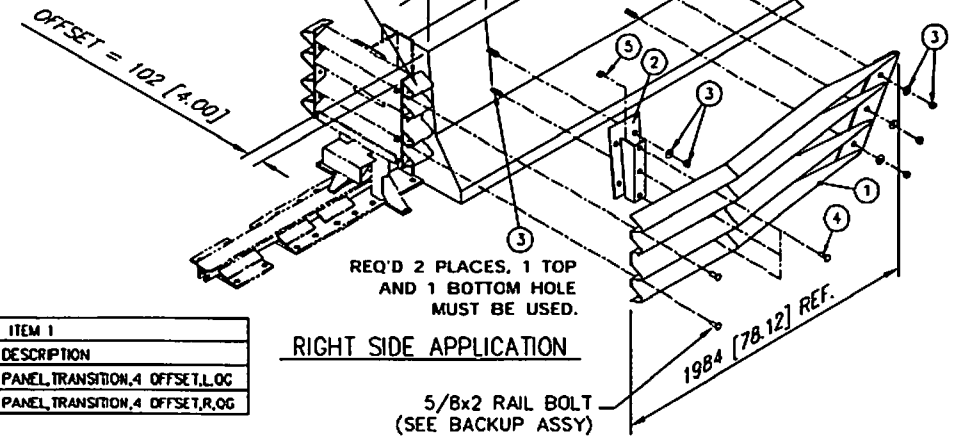
DETAIL A
FREE END REINFORCEMENT
SCALE: 1=24 (SEE NOTES 1 & 3)

PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	REQ'D
1	SEE TABLE	PANEL, TRANSITION, 4 OFFSET, QG	1.00
2	2760301-0000	BRACKET, SUPPORT, 4 TRANS TO CMB	1.00
3	3525130-0000	ANCHOR, MP-3, PT KIT, 3/4X6 1/2 HOR	1.00
4	2699341-0000	BOLT, RAIL, 5/8X2, G	3.00
5	2704191-0000	NUT, HX, 5/8, G, RAIL	3.00

SEE NOTES 2 & 4
SEE DETAIL B



LEFT SIDE APPLICATION



RIGHT SIDE APPLICATION

TABLE - ITEM 1		
APPLICATION	PART NO.	DESCRIPTION
LEFT SIDE	2760281-0000	PANEL, TRANSITION, 4 OFFSET, L, QG
RIGHT SIDE	2760282-0000	PANEL, TRANSITION, 4 OFFSET, R, QG

NOTES:

1. THE CONCRETE BARRIER REINFORCEMENT SHOWN IN DETAIL "A" IS RECOMMENDED TO ENSURE ADEQUATE BARRIER INTEGRITY FOR PROPER IMPACT PERFORMANCE. IT IS APPROPRIATE FOR A STANDARD SAFETY SHAPED BARRIER WITH A 610 [24.00] BASE AND A 150 [6.00] TOP. VARIATIONS MAY BE REVIEWED AND DETERMINATIONS MADE AS TO REASONABLE EQUIVALENCE BY PROJECT ENGINEER.
2. USE TRANSITION PANEL AS TEMPLATE FOR DRILLING. RECOMMENDED HOLE DEPTH 127 [5.00] FINAL TORQUE TO BE 163Nm [120 FT-LBS] (TYP).
3. IMPACT FORCES COULD BE TRANSFERRED INTO TERMINAL END OF THE BARRIER. ADEQUATE ANCHORAGE IS REQUIRED FOR PROPER IMPACT PERFORMANCE.
4. ANCHOR STUD END SHOULD BE FLUSH WITH OUTSIDE SURFACE OF ANCHOR NUT, SEE DETAIL B.
5. MIN. 27.6 MPa [4000 PSI] P.C. CONCRETE MEDIAN BARRIER.

Revisions	Date	Rev.	By	Ckd.	App.
REVISED DIM'S.	07/13/98	E	DOS	KRM	SPT
REVISED ITEM 3 NOTES	06/25/99	F	LWC	KM	SPT
ADD DETAIL C	10/09/01	G	RSC	BWD	FP

REFERENCES

DESIGN	J. Espinoza	DATE	08/21/96
REVISION	J. WELCH	DATE	8/21/96
CHECKED	B. Burgos	DATE	8/27/96
APPROVED	S. Turner	DATE	8/27/96
CAD FILE	354018.dwg		
MEET ASSOCIATION			

LEFT ASSEMBLY NO. 354018L-0000
RIGHT ASSEMBLY NO. 354018R-0000
ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

TRANSITION ASSY, 4 OFFSET, QG

SCALE	FIG.	SHEET	NO.	REV.
N.T.S.	35-40-18	1 of 1		G

REV.	BY	CHKD.	DATE	DESCRIPTION
1	ASG	DLJ	10/27/97	REVISIONS
2	ASG	DLJ	10/27/97	UPDATED CART SUPPORT & RAIL END HOLE
3	ASG	DLJ	10/27/97	REMOVED NOTE 7

2 USE TRANSITION PANEL AS TEMPLATE FOR DRILLING.
 RECOMMENDED HOLE DEPTH 127 (5.00) INCHES FINAL TORQUE TO BE 163 Nm (120 FT-LBS) (TYP).

REFERENCES

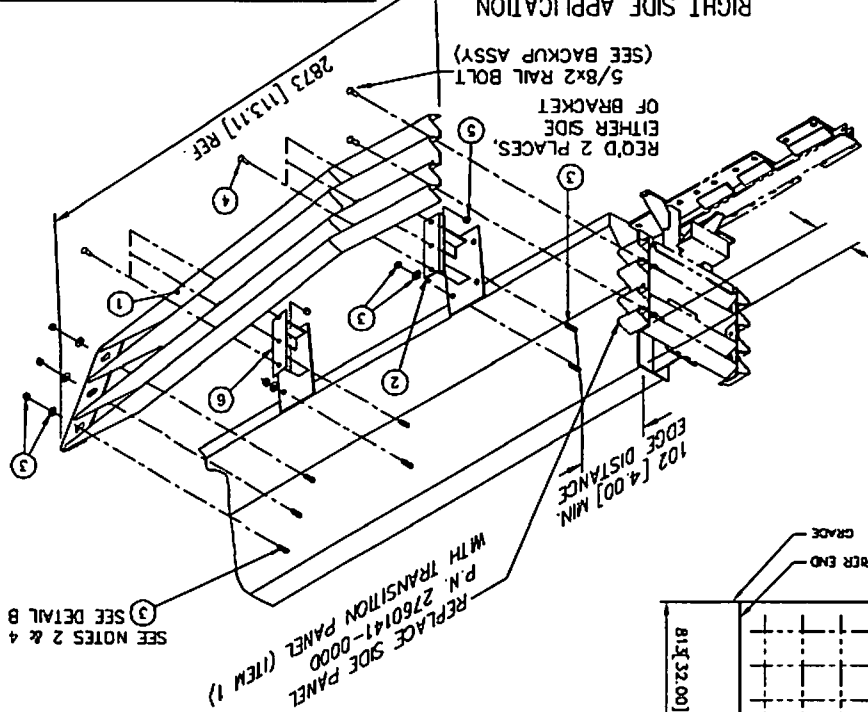
DATE	BY	DESCRIPTION
7/31/97	J. Espinoza	DESIGNED
01/29/97	B. Burgos	CHECKED
01/29/97	S. Turner	APPROVED
01/29/97	S. Turner	DATE

354029.dwg
 CAD FILE

TRANSITION ASSY, 9 OFFSET, 00
 N.T.S.
 35-40-29
 1 of 1
 B

LEFT ASSEMBLY NO. 354029L-0000
 RIGHT ASSEMBLY NO. 354029R-0000
 ENERGY ABSORPTION SYSTEMS, INC.
 ENGINEERING AND RESEARCH DEPARTMENT

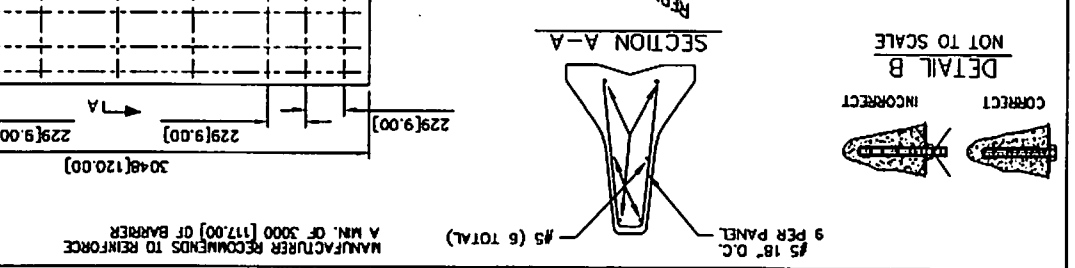
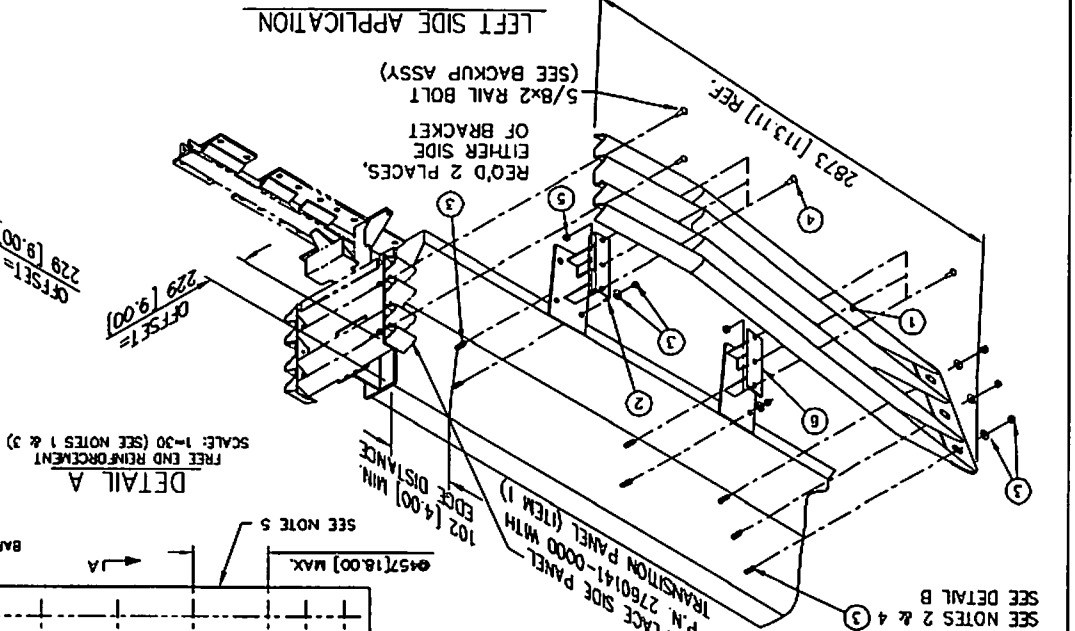
TABLE	ITEM 1 PART NO.	ITEM 6 PART NO.
APPLICATION	2760285-0000	2760304-0000
LEFT SIDE	2760285-0000	2760304-0000
RIGHT SIDE	2760286-0000	2760305-0000



PARTS LIST

ITEM	STOCK NO.	DESCRIPTION	QTY
1	SEE TABLE	PANEL, TRANSITION, 9 OFFSET, (L OR R), 00	1.00
2	2760303-0000	BRACKET, SUPP. FRONT, 9 TRANS	1.00
3	3525130-0000	ANCHOR, MP-3PT KT, 3/4x6 1/2 HOR	2.00
4	269341-0000	BOLT, RAIL, 5/8x2.C	6.00
5	2704191-0000	NUT, HX, 5/8, GAL	6.00
6	SEE TABLE	BRKT, SUPP. REAR, (L OR R), 9 TRANS	1.00

NOTES:
 1. THE REINFORCEMENT SHOWN IN DETAIL 'A' IS RECOMMENDED FOR PORTABLE CONCRETE BARRIER TO ENSURE ADEQUATE BARRIER INTEGRITY WHEN USED IN COMBINATION WITH THE TRANSITION PANEL. THE DETAIL SHOWN IS BASED ON STATE OF CALIFORNIA STANDARD PLANS FOR TEMPORARY RAILING (TYPE K) VARIATIONS MAY BE REVIEWED AND DETERMINATIONS MADE AS TO REASONABLE EQUIVALENCE BY PROJECT ENGINEER.
 2. USE TRANSITION PANEL AS TEMPLATE FOR DRILLING.
 RECOMMENDED HOLE DEPTH 127 (5.00) INCHES FINAL TORQUE TO BE 163 Nm (120 FT-LBS) (TYP).

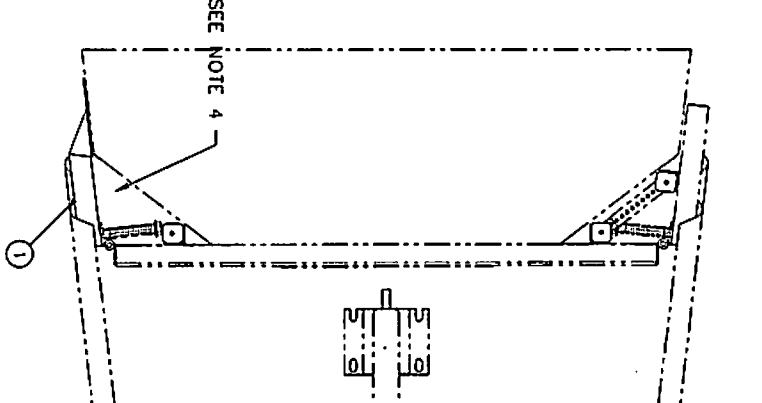
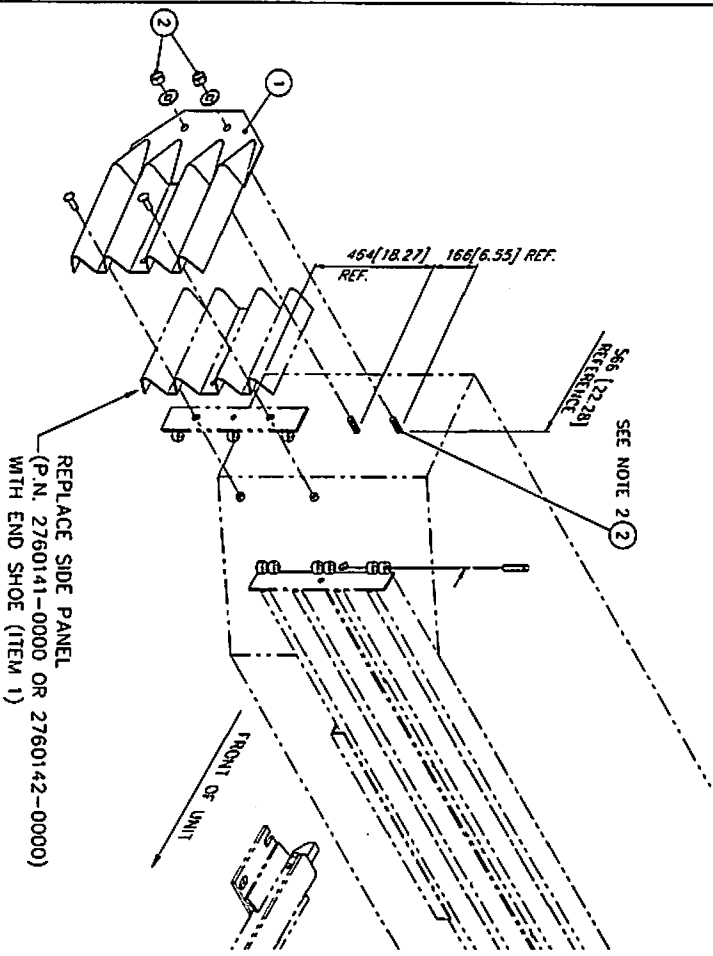


DETAIL B
 NOT TO SCALE
 CORRECT INCORRECT
 9 PER PANEL
 #5 (6 TOTAL)

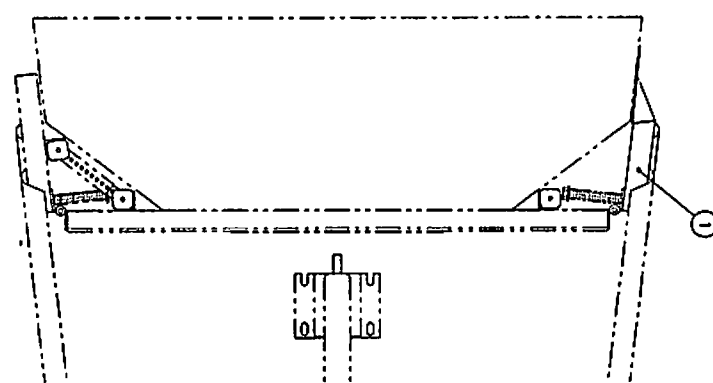
DETAIL A
 FRET END REINFORCEMENT
 SCALE: 1-30 (SEE NOTES 1 & 3)

ITEM	STOCK NO.	DESCRIPTION	QTY
1	2760271-0000	SIDE PANEL, END SHOE, Q.G.	1.00
2	3525130-0000	ANCHOR, MP-3, PT KIT, 3/4X6 1/2 HOR	1.00

PARTS LIST



LEFT SIDE APPLICATION



RIGHT SIDE APPLICATION

- NOTES:**
1. DIMENSIONS ARE IN MILLIMETERS (INCHES).
 2. USE END SHOE AS TEMPLATE FOR DRILLING. RECOMMENDED HOLE DEPTH 127 (5.00) FINAL TORQUE TO BE 163Nm (120 FT-LBS) (TYP). ANCHOR STUD END SHOULD BE FLUSH WITH OUTSIDE SURFACE OF ANCHOR NUT.
 3. CONCRETE BACKUP SHOWN, TENSION STRUT SIMILAR.
 4. BRACE IS NOT REQUIRED WITH END SHOE ATTACHMENT.

REFERENCES

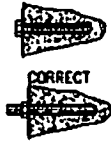
Revisions	Date	Rev	By	Clk/APP
ASSY. NO. WAS 3540151-0000	10/07/97	A	HNI BB	SPT

DATE	BY	APP	DATE	BY	APP
09/16/97	JMF	ogle	5/27/97	JVA	ochodo
9/17/97	KRM		9/17/97	SPT	

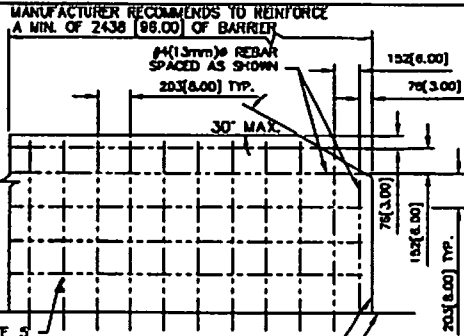
ASSEMBLY NO. 3540150-0000

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

QUADGUARD® SYSTEM
END SHOE ASSY, QG WIDE

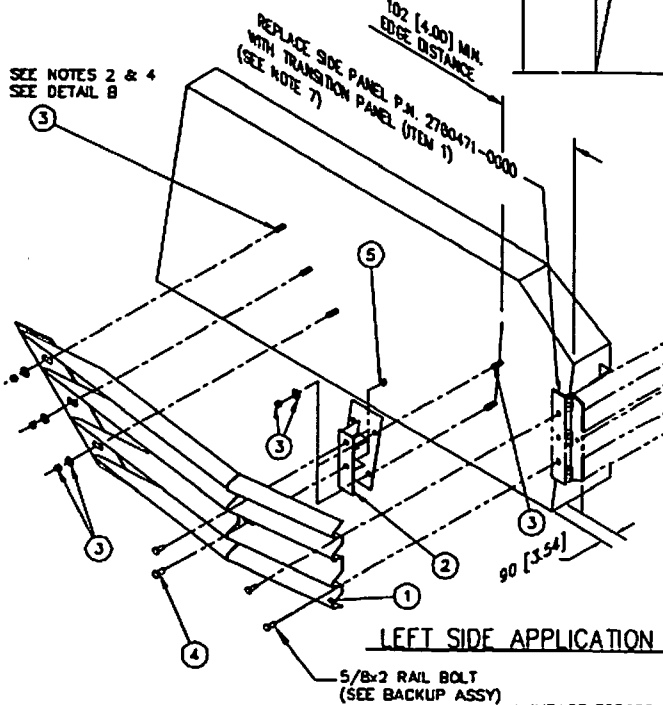


INCORRECT
DETAIL B
NOT TO SCALE



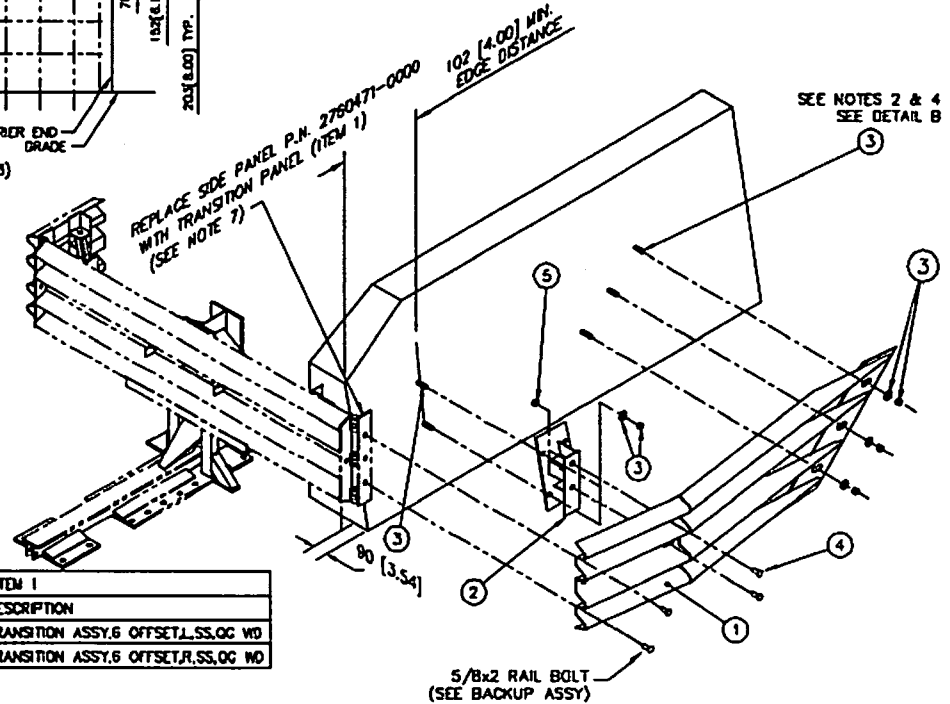
DETAIL A BARRIER END GRADE
FREE END REINFORCEMENT
SCALE: 1=30 (SEE NOTES 1 & 3)

PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	REQ'D
1	SEE TABLE	PANEL, TRANSITION, 6 OFFSET, SS, QG90	1.00
2	2780516-0000	BRACKET, SUPPORT, 6 TRANS, QG, SS	1.00
3	3525130-0000	ANCHOR, MP-3, PT KIT, 3/4XB 1/2 HOR	1.00
4	2899341-0000	BOLT, RAIL, 5/8X2, G	2.00
5	2704191-0000	NUT, HX, 5/8, G, RAIL	2.00



LEFT SIDE APPLICATION

TABLE - ITEM 1		
APPLICATION	PART NO.	DESCRIPTION
LEFT SIDE	2780525-0000	TRANSITION ASSY, 6 OFFSET, L, SS, QG WD
RIGHT SIDE	2780526-0000	TRANSITION ASSY, 6 OFFSET, R, SS, QG WD



RIGHT SIDE APPLICATION

NOTES:

1. THE CONCRETE BARRIER REINFORCEMENT SHOWN IN DETAIL "A" IS RECOMMENDED TO ENSURE ADEQUATE BARRIER INTEGRITY FOR PROPER IMPACT PERFORMANCE. IT IS APPROPRIATE FOR A STANDARD SAFETY SHAPED BARRIER WITH A 610 [24.00] BASE AND A 150 [6.00] TOP. VARIATIONS MAY BE REVIEWED AND DETERMINATIONS MADE AS TO REASONABLE EQUIVALENCE BY PROJECT ENGINEER.
2. USE TRANSITION PANEL AS TEMPLATE FOR DRILLING. RECOMMENDED HOLE DEPTH 127 [5.00] FINAL TORQUE TO BE 163Nm [120 FT-LBS] (TYP).
3. IMPACT FORCES COULD BE TRANSFERRED INTO TERMINAL END OF THE BARRIER. ADEQUATE ANCHORAGE IS REQUIRED FOR PROPER IMPACT PERFORMANCE.
4. ANCHOR STUD END SHOULD BE FLUSH WITH OUTSIDE SURFACE OF ANCHOR NUT. SEE DETAIL B.
5. MIN. 27.8 MPa [4000 PS] P.C. CONCRETE MEDIAN BARRIER.
6. SEE COVER SHEET FOR BACKUP TO BARRIER LAYOUT. BACKUP SIDE PLATE TO BE APPROX 90 [3.5] INWARD OF TOE OF BARRIER.
7. BRACE NOT REQUIRED WITH OFFSET TRANSITION.

REFERENCES

DESIGNED	DATE
S. Cholda	11/09/98
DRAWN	DATE
BB	11/10/98
CHECKED	DATE
STT	11/10/98
CAD FILE: 3540490-0000.dwg	
NEXT ASSEMBLY	



ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

QUADGUARD® SYSTEM
TRANSITION ASSY, 6 OFFSET, SS, QG W

Revisions	Date	Rev.	By	Ckd.	App.
ADDED NOTE 7	06/17/99	A	LWC	KW	SPT
ADDED DIM. AT TOE OF BARRIER	12/08/00	B	RSG	DWO	SPT
REVISED TITLE & DESCRIPTIONS IN TABLE					

