QuadGuard® System

The New Standard In Crash Cushions...
NCHRP 350, TL-3!

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QuadGuard® System

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Note: This manual and the standard drawings with their reference drawings in PDF format are also contained on the CD included on the inside back cover of this manual.

Important Introductory Notes

Proper installation of the QuadGuard System is essential to assure maximum performance. Take the time to review the installation instructions and product limitations thoroughly before performing the necessary work. Do not attempt to install any crash cushion without the proper plans and installation manual from the manufacturer.

Note: The drawing package provided with the QuadGuard System should take precedence over the drawing package provided in this manual. These drawings are for reference only and may not be up to date.

System Overview

If you need additional information, or have questions about the QuadGuard System, please call Energy Absorption Systems’ Customer Service Department at (888) 323-6374.

The QuadGuard System is a highly efficient, redirective, non-gating crash cushion for hazards ranging in width from 610 mm to 2285 mm (2' to 7.5'). It consists of crushable, energy-absorbing cartridges surrounded by a framework of Quad-Beam™ panels.

The QuadGuard System utilizes two types of cartridges in a "staged" configuration to address both lighter cars and heavier, high center-of-gravity vehicles. Its modular design allows the system length to be tailored to the design speed of a site. Refer to Table A on page 9 to determine the appropriate length system for a given design speed.

How to Determine Left/Right

To determine left from right when ordering parts, stand in front of the system facing the hazard as shown in Figure 1. Your left is the system’s left and your right is the system’s right.

Counting the Number of Bays

One bay consists of one cartridge, one diaphragm, and two fender panels. The nose section is not considered a bay, though there is a cartridge in the nose of each system. Note that this means there will always be one more cartridge in the system than the number of bays in the system. To determine number of bays, count fender panels on one side, see Figure 1 (5 bay System shown).
QuadGuard® System

System Overview (cont’d.)

Measuring the Width
The QuadGuard System is available in five nominal widths:

- 610 mm [24”]
- 760 mm [30”]
- 915 mm [36”]
- 1755 mm [69”]
- 2285 mm [90”]

The nominal width of a system with tension strut backup is the width between side panels behind the backup (see Figure 2).

The nominal width of a system with concrete backup is the width of the concrete backup at location shown in Figure 3.

The outside width of the system is approximately 150 mm [6”] to 230 mm [9”] wider than the nominal width. The width of the system is not the same as the width of the backup.

Crash Performance
The 6 bay QuadGuard System has successfully passed the NCHRP 350, Test Level 3 tests with both the light car and pickup truck at speeds up to 100 km/h (62 mph) at angles up to 20 degrees.

During head-on impacts, the QuadGuard System telescopes rearward and crushes to absorb the energy of impact. When impacted from the side, it safely redirects the vehicle back toward its original travel path and away from the hazard.

Return Goods Policy
Before returning any goods for credit please contact Energy Absorption Systems Inc. Customer Service Department at 1-888-323-6374 or your local distributor for proper instructions.
QuadGuard® System

QuadGuard® System
General Specifications

I. GENERAL

All QuadGuard Systems are designed and manufactured by Energy Absorption Systems, Incorporated, of Chicago, Illinois.

II. DESCRIPTION OF SYSTEM

A. General

The QuadGuard System consists of energy absorbing cartridges surrounded by a framework of steel Quad-beam guardrail, which can telescope rearward during head-on impacts. The QuadGuard System has a center monorail, which will resist lateral movement during side angle impacts, and a backup, which will resist movement during head-on impacts. The nose consists of a formed plastic nose wrap and an energy-absorbing cartridge. Transitions are available and may be required depending on site conditions.

B. Component Descriptions

1. A bay describes a section of the QuadGuard System consisting of an energy absorbing cartridge, a diaphragm, two fender panels and fasteners.
   a. There are two types of cartridges, referred to as Type I and Type II. The front portion of the system is fitted with Type I cartridges. The rear of the system is fitted with Type II cartridges. The outside of each cartridge is fabricated from a weather resistant plastic. The actual quantity of each is determined by the system design speed. Refer to the product design manual for more information.
   b. The diaphragms are made from 10 gauge, steel Quad-Beam sections. Two support legs are welded to the Quad-Beam. Ski-shaped plates are welded to the bottom of the support legs. The diaphragms are designed to lock onto, and be guided by a ground-mounted, center monorail support structure.
   c. The fender panels are fabricated from 10 gauge steel Quad-Beam sections. The rear of each fender panel (the panel end furthest from the nose of the assembled system) is tapered to help maximize performance during wrong-way, redirective impacts. Each fender panel is drilled and slotted in accordance with the manufacturer’s specifications so that when assembled in the field, the front end (the end closest to the nose of the assembled system) is bolted to a diaphragm or hinge plate (depending on width of system) by means of 5/8” bolts. The rear of each Quad-beam fender panel overlaps the next rearward fender panel and is connected to the diaphragm or hinge plate of the next bay by means of a bolt and “mushroom” washer. The bolt fits through the long horizontal slot in the forward fender panel. This permits the movement, front to back, of one set of fender panels relative to the panels in the underlying, next rearward bay. For QuadGuard Systems with a backup width greater than 915mm (36”), the mushroom bolt assembly is held in place by a compression spring, which allows limited separation of the fender panels during an impact.

2. The monorail support structure is made of steel and is to be anchored per manufacturer’s instructions, to a specified concrete pad. The monorail prevents lateral movement, vertical movement and overturning of the diaphragms during design impacts.
QuadGuard® System

QuadGuard® System
General Specifications (cont’d.)

3. The nose section contains a nose cover and an energy absorbing cartridge and is not counted as a bay. The nose cover is made from a plastic material formulated to resist weathering. The nose attaches to the front diaphragm. Standard colors are gray or yellow.

4. The backup is made of steel and is attached to concrete or an integral tension strut framework, and is available in nominal widths of 610mm (24’), 762mm (30’), 915mm (36’), 1753mm (69’), and 2286mm (90’).

5. Several transition panels are available as required by site conditions including: Quad-Beam to Safety Barrier, Quad-Beam to Thrie-Beam, Quad-Beam to W-Beam, and Quad-Beam End Shoe. Contact Energy Absorption Systems, Inc. for specific applications.

C. Material Specifications

1. Metal work is fabricated from either M1020 Merchant Quality or ASTM A-36 steel. After fabrication, metal work is galvanized in accordance with ASTM A-123. All welding is done by or under the direction of a certified welder.

2. The system is assembled with galvanized fasteners. All bolts, nuts, and washers are Commercial Quality "American National Standard" unless otherwise specified.

III. PERFORMANCE CRITERIA

A. For head-on impacts into the nose, a QuadGuard® System shall be specified which is capable of meeting the occupant risk criteria as recommended in NCHRP 350. For vehicles weighing between 820 and 2000 kg [1,810 and 4,410 lbs], the theoretical impact velocity of a hypothetical front seat passenger against the vehicle’s interior (calculated from vehicle acceleration and 600mm [24’] forward displacement) shall be less than 12m/s [39.4 ft/sec], and the vehicle’s highest 10 millisecond average acceleration subsequent to the instant of the hypothetical passenger impact shall be less than 20 G’s.

B. The QuadGuard System is capable of redirecting 2000 kg [4,410 lbs] vehicles which impact the sides of the system at speeds up to 100 km/h [62 mph] at angles of 20° (angles measured from system’s longitudinal centerline). The QuadGuard System is capable of redirecting 820 kg [1,810 lbs] vehicles, which impact the sides of the system at speeds up to 100 km/h [62 mph] at angles of 15°. (See Test Criteria below.)

C. The QuadGuard System is designed and constructed so there is no solid debris from the system which can create a hazard on the roadway after either head-on or side angle design impacts.

IV. TEST CRITERIA

The QuadGuard System has been fully tested per the recommended criteria set forth in National Cooperative Highway Research Program (NCHRP) Report 350, 1993, Test Level 3 for redirective, non-gating terminals and crash cushions.

V. DESIGN AND SELECTION CRITERIA


B. Installation of the QuadGuard System attenuators shall be accomplished in accordance with the recommendations of Energy Absorption Systems, Incorporated.
QuadGuard® System

QuadGuard® CZ System
General Specifications

I. GENERAL
All QuadGuard CZ Systems are designed and manufactured by Energy Absorption Systems, Incorporated, of Chicago, Illinois.

II. DESCRIPTION OF SYSTEM
A. General
The QuadGuard CZ System consists of energy absorbing cartridges surrounded by a framework of steel Quad-beam® guardrail which can telescope rearward during head-on impacts. The QuadGuard CZ System has a center monorail which will resist lateral movement during side angle impacts and a backup which will resist movement during head-on impacts. The nose consists of a flexible nose wrap and an energy-absorbing cartridge. Transitions are available and may be required depending on site conditions.

The QuadGuard CZ System is available in 3 to 9 bay lengths and nominal widths of 610mm [24"], 762mm [30"], and 915mm [36"].

B. Component Descriptions
1. A bay describes a section of the QuadGuard CZ System consisting of an energy absorbing cartridge, a diaphragm, two fender panels and fasteners.
   a. There are two types of cartridges, referred to as Type I and Type II. The front portion of the system is fitted with Type I cartridges. The rear of the system is fitted with Type II cartridges. The outside of each cartridge is fabricated from a weather resistant plastic. The actual quantity of each is determined by the system design speed. Refer to the product design manual for more information.
   b. The diaphragms are made from 10 gauge, steel Quad-beam sections. Two support legs are welded to the Quad-beam. Ski-shaped plates are welded to the bottom of the support legs. The diaphragms are designed to lock onto and be guided by a ground-mounted, center monorail support structure.
   c. The fender panels are fabricated from 10 gauge steel Quad-beam sections. The rear of each fender panel (the panel end furthest from the nose of the assembled system) is tapered to help maximize performance during wrong-way, redirective impacts. Each fender panel is drilled and slotted in accordance with the manufacturer’s specifications so that when assembled in the field, the front end (the end closest to the nose of the assembled system) is bolted to a diaphragm by means of 5/8” bolts. The rear of each Quad-beam fender panel shall overlap the next rearward fender panel and be connected to the diaphragm of the next bay by means of a bolt and “mushroom” washer. The bolt fits through the long horizontal slot in the forward fender panel. This permits the front to back movement, of one set of fender panels relative to the panels in the underlying, next rearward bay.

2. The nose section shall contain a nose cover and an energy-absorbing cartridge and is not counted as a bay. The nose cover is made from flexible belting material combined with synthetic fiber reinforcement. The nose shall attach to the front diaphragm. Standard colors are gray or yellow.

3. The monorail support structure is made of steel and be anchored per manufacturer’s instructions, to specified concrete pad or asphalt roadway. The monorail shall prevent lateral movement, vertical movement and overturning of the diaphragms during design impacts.

4. The backup is made of steel and be attached to an integral tension strut framework, and is available in nominal widths of 610mm[24"], 760mm[30"], 915mm[36"].

5. Optional Plate - The monorail backup section and the monorail extension section are available welded to steel plate sections. The plates shall be anchored per manufacturer’s instructions, to a specified concrete pad or asphalt roadway.
QuadGuard® System

QuadGuard® CZ System

General Specifications (cont’d.)

a. The monorail backup section is 3 bays long on a 10mm x 1.07m x 4.16m [3/8” x 3’6” x 13’7-5/8”] plate. The backup and monorail are welded to the plate. The backup monorail section is available in normal widths of 610mm[24’’], 760mm[30’’] and 915mm[36’’].

b. The monorail extension section is 3 bays long and can be added as required to the monorail backup section to make 4 to 9 bays systems. The plate of a monorail extension section is 10mm x 1.07m x 2.74m [3/8” x 3’6” x 9’]. The monorail extension sections shall prevent lateral movement, vertical movement and overturning of the diaphragms during design impacts.

6. Several transition panels are available as required by site conditions including: Quad-beam to Safety Barrier, Quad-beam to Thrie-beam, Quad-beam to W-beam, and Quad-beam End Shoe. Transitions may be necessary to minimize potential vehicle snag conditions. Contact Energy Absorption Systems, Inc. for specific applications.

C. Material Specifications

1. Metal work is fabricated from either M1020 Merchant Quality or ASTM A-36 steel. After fabrication, metal work is galvanized in accordance with ASTM A-123. All welding is done by or under the direction of a certified welder.

2. The system is assembled with galvanized fasteners. All bolts, nuts, and washers are Commercial Quality “American National Standard” unless otherwise specified.

III. PERFORMANCE CRITERIA

A. The QuadGuard® CZ System is capable of redirecting 820 to 2000 kg [1,810 to 4,410 lbs] vehicles which impact the sides of the system at speeds up to 100 km/h [62 mph] at angles of 20 degrees for both right-way and wrong-way impacts (angles measured from system’s longitudinal centerline). (See Test Criteria below.)

B. For head-on impacts into the nose, a QuadGuard CZ is capable of meeting the occupant risk criteria as recommended in NCHRP 350. For vehicles weighing between 820 and 2000 kg [1,810 and 4,410 lbs], the theoretical impact velocity of a hypothetical front seat passenger against the vehicle’s interior (calculated from vehicle acceleration and 610mm [24’’] forward displacement) shall be less than 12m/s [39.4 ft/sec]. The vehicle’s highest 10 millisecond average acceleration subsequent to the instant of the hypothetical passenger impact shall be less than 20 G’s.

C. The QuadGuard CZ System is designed and constructed so there is no solid debris from the system which can create a hazard on the roadway after either head-on or side angle design impacts.

IV. TEST CRITERIA

The six bay QuadGuard CZ System has been tested per the recommended criteria set forth in National Cooperative Highway Research Program (NCHRP) Report 350, 1993, Test Level 3 for redirective, non-gating terminals and crash cushions.

V. DESIGN AND SELECTION CRITERIA


B. Installation of the QuadGuard CZ System attenuators shall be accomplished in accordance with the recommendations of Energy Absorption Systems, Incorporated.
QuadGuard® System

QuadGuard System Design Criteria

Establish Basic System Specifications

The specification of a QuadGuard System for a particular site must always include system width and system length.

1) Specification of System Width

The QuadGuard System is available in five nominal widths:
- 610 mm [24”]
- 760 mm [30”]
- 915 mm [36”]
- 1755 mm [69”]
- 2285 mm [90”]

As a general rule, selection of the narrowest width that adequately shields the hazard is recommended.

2) Specification of System Length

System length is specified by the number of bays the system includes. The number of bays required is a function of the design speed of the roadway. Refer to Table A on page 9 to correlate the design speed of the roadway with the number of bays which should be specified.

Example of Basic System Specification

To shield a 710 mm [28"] hazard on a roadway with a design speed of 90 kph [56 mph], the designer would call for a 5-bay system with a 760 mm [30"] backup. (See Table B on page 10 for model numbers.)

Choose a Backup Structure for the System

Two backup designs are available. The Tension Strut backup and the concrete backup. Both types are appropriate for use on grade or deck.

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 (delinicators or signs) present at the site? What height and width are they? All curbs and elevated objects over 100 mm [4"] high should be removed. If possible, curbs under 100 mm [4"] high should be removed approximately 15 m [50"] in front of the QuadGuard® System, and as far back as the system’s backup. Any curbs that must remain should be 100 mm [4"] maximum and be mountable.

2. If the installation site is a gore area, (place where two roads diverge), what is the angle of divergence?

3. What is the general geometry of the site, including the roadway for 150 m [500"] in front, so traffic patterns can be visualized?

4. Is there an existing barrier? When there is an existing guardrail or median barrier at the site, the backup of the QuadGuard System should tie into it when possible.

5. Will there be traffic approaching from the rear of the system? Is the system in a two-way traffic situation, with traffic going in opposite directions on either side of the system? Or, is the system on the side of the road in a location where cross over traffic is a concern? If so, a Transition from the back of the system to the hazard is necessary to prevent vehicle snagging (see Page 17).

6. Are there any other unique features at the site that may affect positioning or performance of the QuadGuard System? (See next section).

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.

If these or any other special site conditions exist, please contact Energy Absorption Systems Customer Services Department before proceeding with your design. For Customer Service call: 1-888-323-6374.
QuadGuard® System

QuadGuard System Design Criteria (cont’d.)

Table A

QuadGuard Design Table (Avg G deceleration values)

<table>
<thead>
<tr>
<th>No. Bays</th>
<th>Effective Length</th>
<th>Design Velocity km/h (mph)</th>
<th>40 (25)</th>
<th>50 (31)</th>
<th>60 (37)</th>
<th>70 (44)</th>
<th>80 (50)</th>
<th>90 (56)</th>
<th>100 (62)</th>
<th>105 (65)</th>
<th>110 (68)</th>
<th>115 (71)</th>
<th>120 (75)</th>
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</thead>
<tbody>
<tr>
<td>12*</td>
<td>11.79 m (38'-8&quot;)</td>
<td>120 (75)</td>
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<td>---</td>
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<td>---</td>
<td>---</td>
<td>5.2</td>
<td>5.6</td>
<td>5.1</td>
<td>5.6</td>
</tr>
<tr>
<td>11*</td>
<td>10.87 m (35'-8&quot;)</td>
<td>120 (75)</td>
<td>---</td>
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<td>---</td>
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<td>---</td>
<td>5.2</td>
<td>5.6</td>
<td>6.1</td>
<td>6.1</td>
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<tr>
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<td>9.96 m (32'-8&quot;)</td>
<td>120 (75)</td>
<td>---</td>
<td>---</td>
<td>---</td>
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<td>---</td>
<td>---</td>
<td>5.6</td>
<td>6.1</td>
<td>6.7</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>9.04 m (29'-8&quot;)</td>
<td>115 (71)</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>5.6</td>
<td>6.2</td>
<td>6.8</td>
<td>7.4</td>
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<td>8*</td>
<td>8.13 m (26'-8&quot;)</td>
<td>110 (68)</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>5.7</td>
<td>6.3</td>
<td>6.9</td>
<td>7.5</td>
<td>8.2</td>
<td></td>
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</tr>
<tr>
<td>7*</td>
<td>7.21 m (23'-8&quot;)</td>
<td>105 (65)</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>5.2</td>
<td>6.4</td>
<td>7.1</td>
<td>7.8</td>
<td>8.5</td>
<td>9.2</td>
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<tr>
<td>6</td>
<td>6.30 m (20'-8&quot;)</td>
<td>100 (62)</td>
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<td>---</td>
<td>---</td>
<td>4.7</td>
<td>5.9</td>
<td>7.3 (TL-3)</td>
<td>8.1</td>
<td>8.9</td>
<td>9.7</td>
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<tr>
<td>5*</td>
<td>5.38 m (17'-8&quot;)</td>
<td>90 (56)</td>
<td>---</td>
<td>---</td>
<td>4.2</td>
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<td>7.0</td>
<td>8.6</td>
<td>9.5</td>
<td>10.4</td>
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<td>4*</td>
<td>4.47 m (14'-8&quot;)</td>
<td>80 (50)</td>
<td>---</td>
<td>3.7</td>
<td>5.1</td>
<td>6.6</td>
<td>8.4</td>
<td>10.4</td>
<td>---</td>
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<td>3</td>
<td>3.56 m (11'-8&quot;)</td>
<td>70 (44)</td>
<td>---</td>
<td>3.2</td>
<td>4.7</td>
<td>6.4 (TL-2)</td>
<td>8.3</td>
<td>10.5</td>
<td>---</td>
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<tr>
<td>2*</td>
<td>2.64 m (8'-8&quot;)</td>
<td>60 (37)</td>
<td>2.8</td>
<td>4.4 (TL-1)</td>
<td>6.3</td>
<td>8.6</td>
<td>11.2</td>
<td>---</td>
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<td>---</td>
<td>---</td>
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<td></td>
</tr>
<tr>
<td>1*</td>
<td>1.73 m (5'-8&quot;)</td>
<td>40 (25)</td>
<td>4.3</td>
<td>6.7</td>
<td>9.6</td>
<td>---</td>
<td>---</td>
<td>---</td>
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</tbody>
</table>

*System capacity estimated through calculation.
Avg G deceleration values are based upon average values calculated for vehicles 820 to 2000 kg (1800 to 4400 lbs.) that stop in a distance equal to 85% of the systems length.

**WARNING!**

Shaded area denotes excessive decelerations based upon occupant risk recommendations outlined in NCHRP 350 for 2000 kg (4400 lb.) vehicles. Energy Absorption Systems, Inc. does not recommend choosing systems from this area of the chart.

TL-1
TL-2
TL-3

Impact conditions which differ from those described in the NCHRP 350 test matrix 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 (at the site of the installation) of curbs or cross slopes in excess of 8%, may yield crash performance which does not meet NCHRP 350 evaluation criteria relative to structural adequacy, occupant risk and vehicle trajectory factors.
### QuadGuard® System

**QuadGuard System Design Criteria (cont’d.)**

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**Table B**

**QuadGuard Standard System Model Numbers**

<table>
<thead>
<tr>
<th>Number of Bays</th>
<th>Nominal Width</th>
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<tbody>
<tr>
<td></td>
<td>610 mm [24&quot;]</td>
</tr>
<tr>
<td>1</td>
<td>QS2401G or Y</td>
</tr>
<tr>
<td>2</td>
<td>QS2402G or Y</td>
</tr>
<tr>
<td>3</td>
<td>QS2403G or Y</td>
</tr>
<tr>
<td>4</td>
<td>QS2404G or Y</td>
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<td>QS2405G or Y</td>
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<td>6</td>
<td>QS2406G or Y</td>
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<td>7</td>
<td>QS2407G or Y</td>
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<td>8</td>
<td>QS2408G or Y</td>
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<td>9</td>
<td>QS2409G or Y</td>
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<td>11</td>
<td>QS2411G or Y</td>
</tr>
<tr>
<td>12</td>
<td>QS2412G or Y</td>
</tr>
</tbody>
</table>

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**Model Number Description**

- **QuadGuard System**
- **Number of Bays (01-12)**
- **Nominal Width of Backup**
  - (610 mm [24"], 760 mm [30"], 915 mm [36"], 1755 mm [69"], 2285 mm [90"])
- **Nose Color ( Gray [G] or Yellow [Y] )**
- **Standard(S) or Non-Standard(N)**

**Figure 9**

*Model Number Key*
QuadGuard® System

QuadGuard System Design Criteria (cont’d.)

QUADGUARD SYSTEM FOR NARROW HAZARDS

610 mm [24"] MODEL NO. QS2406

760 mm [30"] MODEL NO. QS3006

915 mm [36"] MODEL NO. QS3606

QUADGUARD SYSTEM FOR WIDE HAZARDS

1755 mm [69"] MODEL NO. QS6906

2285 mm [90"] MODEL NO. QS9006

6.74 m [22’-1 3/8"]

Figure 10

Plan & Elevation (Six bay System with Tension Strut backup Shown)

Key
1. Cartridge
2. Diaphragm
3. Quad Beam Fender Panel
4. Nose Cover
5. Monorail
6. Backup
QuadGuard® System

QuadGuard cz Design Criteria

The portable compact crash cushion for construction zones. The QuadGuard cz is available in the same narrow sizes as permanent systems.

A wise choice…

because the Construction Zone QuadGuard (QuadGuard cz) provides the same lifesaving efficiency and features of the permanent QuadGuard System. 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.

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 permanently installed.

because the QuadGuard cz is crush efficient. Cartridges offer exceptional energy absorbing efficiency. With variable design lengths systems can be tailored to meet your design criteria. The QuadGuard cz offers the best size/efficiency ratio of any impact attenuator. Thus, the shortest system possible for a given design speed can be installed. 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 so that the width and length are no larger than necessary.

The QuadGuard cz must be properly anchored. Refer to Page 14 for the recommended anchorage for various foundations.

### QuadGuard cz Design Criteria

QuadGuard cz on a Plate Model Numbers

<table>
<thead>
<tr>
<th>Number of Bays</th>
<th>Nominal Width</th>
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<td>610 mm [24&quot;]</td>
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<tr>
<td>4</td>
<td>QZ2404PG or Y</td>
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<td>5</td>
<td>QZ2405PG or Y</td>
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<td>QZ2408PG or Y</td>
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<tr>
<td>9</td>
<td>QZ2409PG or Y</td>
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</table>

#### Table C

**Model Number Description**

- QZ 24 06 P Y
- CONSTRUCTION ZONE(Z)
- NUMBER OF BAYS (03-09)
- NOSE COLOR (GRAY [G] OR YELLOW [Y])
- PLATE/MONORAIL SECTIONS
- WIDTH OF THE BACKUP (610 mm [24"], 760 mm [30"], 915 mm [36"])
- QUADGUARD SYSTEM
QuadGuard® System

QuadGuard cz Design Criteria (cont’d.)

Table D

QuadGuard cz Design Table (Avg G deceleration values)

<table>
<thead>
<tr>
<th>No. Bays</th>
<th>Effective Length</th>
<th>Design Velocity km/h (mph)</th>
<th>40 (25)</th>
<th>50 (31)</th>
<th>60 (37)</th>
<th>70 (44)</th>
<th>80 (50)</th>
<th>90 (56)</th>
<th>100 (62)</th>
<th>105 (65)</th>
<th>110 (68)</th>
<th>115 (71)</th>
<th>120 (75)</th>
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<tr>
<td>9</td>
<td>9.04 m (29'-8&quot;)</td>
<td>115 (71)</td>
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<td>---</td>
<td>---</td>
<td>---</td>
<td>5.6</td>
<td>6.2</td>
<td>6.8</td>
<td>7.4</td>
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<tr>
<td>8*</td>
<td>8.13 m (26'-8&quot;)</td>
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<td>---</td>
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<td>---</td>
<td>5.7</td>
<td>6.3</td>
<td>6.9</td>
<td>7.5</td>
<td>8.2</td>
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<td>7.21 m (23'-8&quot;)</td>
<td>105 (65)</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>5.2</td>
<td>6.4</td>
<td>7.1</td>
<td>7.8</td>
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<td>9.2</td>
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<td>6</td>
<td>6.30 m (20'-8&quot;)</td>
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<td>---</td>
<td>---</td>
<td>4.7</td>
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<td>8.1</td>
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<td>9.7</td>
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<td>8.4</td>
<td>10.4</td>
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<td>---</td>
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<td>3</td>
<td>3.56 m (11'-8&quot;)</td>
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<td>3.2</td>
<td>4.7</td>
<td>6.4 (TL-2)</td>
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<td>10.5</td>
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</table>

*System capacity estimated through calculation.
Avg G deceleration values are based upon average values calculated for vehicles 820 to 2000 kg (1800 to 4400 lbs.) that stop in a distance equal to 85% of the systems length.

WARNING!

Shaded area denotes excessive decelerations based upon occupant risk recommendations outlined in NCHRP 350 for 2000 kg (4400 lb.) vehicles. Energy Absorption Systems, Inc. does not recommend choosing systems from this area of the chart.

TL-2 } Test levels 2 & 3 respectively as defined by NCHRP 350.

Impact conditions which differ from those described in the NCHRP 350 test matrix 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 (at the site of the installation) of curbs or cross slopes in excess of 8%, may yield crash performance which does not meet NCHRP 350 evaluation criteria relative to structural adequacy, occupant risk and vehicle trajectory factors.
QuadGuard® System

QuadGuard cz Foundation Specifications

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

A: Concrete Pad

Foundation: 150 mm [6"] minimum depth
Portland Cement Concrete (P.C.C.)
Anchorage: MP-3® with 180 mm [7"] studs
140 mm [5.5"] embedment

Note: 18" Anchors are supplied with the QuadGuard cz. If another substrate is encountered, please call customer service to discuss options.

B: Asphalt over P.C.C.

Foundation: 75 mm [3"] minimum depth
Asphalt Concrete (A.C.) over 75 mm [3"] minimum (P.C.C.)
Anchorage: MP-3 with 460 mm [18"] studs
420 mm [16.5"] embedment

C: Asphalt over Subbase

Foundation: 150 mm [6"] minimum (A.C.) over
150mm [6in] minimum Compacted Subbase (C.S.)
Anchorage: MP-3 with 460 mm [18"] studs
420 mm [16.5"] embedment

D: Asphalt Only

Foundation: 200 mm [8"] minimum (A.C.)
Anchorage: MP-3 with 460 mm [18"] studs
420 mm [16.5"] embedment

A. C. (Asphalt Concrete)
AR-4000 A. C.
(per ASTM D3381 '83) .75" Maximum,
Medium (Type A or B) aggregate
Sieve Size Operating Range (%)

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<td>65-80</td>
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<tr>
<td>No. 4</td>
<td>49-54</td>
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<tr>
<td>No. 8</td>
<td>36-40</td>
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<tr>
<td>No. 30</td>
<td>18-21</td>
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<tr>
<td>No. 200</td>
<td>3-8</td>
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</table>

P.C.C. (Portland Cement Concrete)
Stone aggregate concrete mix
4000 psi minimum compressive strength
(Sampling per ASTM C31-84
or ASTM C42-84a, testing per ASTM C39-84)

C.S. (Compacted Subbase)
150 mm [6"] minimum depth 95% compaction
Class 2 aggregate
Sieve Size Moving Average % Passing

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Moving Average % Passing</th>
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</thead>
<tbody>
<tr>
<td>3&quot;</td>
<td>100</td>
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<td>2 1/2&quot;</td>
<td>90-100</td>
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<tr>
<td>No. 4</td>
<td>40-90</td>
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<td>No. 200</td>
<td>0-25</td>
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</table>
**QuadGuard® System**

**General Installation Information**

**Required Tools**

**Documentation**
- Manufacturer’s Installation Manual
- Manufacturer’s Drawing Package

**Cutting equipment**
- Rebar Cutting Bit
- 22 mm (7/8”) Concrete Drill Bits (*Two Fluted)
- Grinder, Hacksaw or Torch (optional)
- Drill Motor
- Drill Bits: 1/16” through 7/8”

* Energy Absorption Systems recommends using two fluted drills to achieve optimum tensile strength when installing the MP-3 anchoring system.

**Hammers**
- Roto Hammer
- Sledgehammer
- Standard Hammer

**Wrenches**
- Heavy Duty Impact Wrench
- Standard adjustable wrench
- 1/2" drive sockets: 9/16”, 11/16”, 3/4”, 15/16”, 1 1/8”, 1 1/4”
- Deep Sockets: 5/16”, 1 1/4”
- Ratchet and attachments for the above sockets
- Breaker Bar: 1/2” x 24”
- Torque Wrench: 200 ft-lbs.
- Crescent Wrench: 300 mm [12’]
- Allen Wrench: 3/8”
- Impact Wrench: 1/2”

**Personal protective equipment**
- Safety Glasses
- Gloves

**Miscellaneous**
- Traffic Control Equipment
- Lifting and Moving Equipment (A lifting device is preferred although a forklift can be used.) Minimum 5,000 lb. capacity required.
- Compressor (100 psi) and Generator (5 KW)
- Long Pry Bar
- Drift Pin 300 mm [12’]
- Center Punch
- Tape Measure 7.5 m (25’)
- Chalk Line
- Concrete Marking Pencil
- Nylon bottle brush for cleaning 7/8” drilled holes
- Rags, Water, and Solvent for Touch-up

*Note: The above list of tools is a general recommendation. The actual number of tools required will depend on specific site conditions and the complexity of the installation.*
QuadGuard® System

Transitioning

Quad-Beam End Shoe Transition Panel
The Quad-Beam End Shoe Panel transitions the Quad-Guard System to vertical faced concrete structures whether it is a concrete backup or concrete barrier wall, see Page 17. An Extended End Shoe is also available. In cases where the corners of the hazard are not chamfered it may be necessary to add wheel deflectors to the structure in order to prevent wheel snagging.

Quad-Beam to Guardrail Transition Panel (W-beam and Thrie-Beam)
The Quad-Beam to W-beam and Quad-Beam to Thrie-Beam Transition Panels transition the QuadGuard System to new and existing runs of standard guardrail, see Page 17.

Quad-Beam to Safety Barrier Transition Panel
There are several options available when transitioning the QuadGuard System to safety shape barrier depending on the shape and position of the barrier.

When transitioning to barriers with a “New Jersey” style profile, the 4” offset transition panel is most commonly used, see Page 17. For transitioning to barriers that are in line with the side of the system, use transition assembly 354018L or R. For transitioning a wide system to barrier that runs parallel to the centerline of the system, transition assembly 354042L or R is used. A 9” offset transition panel is also available for transitioning to barriers that are in line with the side of the system.

When transitioning to Single Slope style barriers and parapets, 6” and 8” offset transition panels are available. For transitioning a wide system to barrier that runs parallel to the centerline of the system, a 6” offset panel is available.

How do you determine the transition panel offset?
The Transition Panel Offset is determined by measuring the distance between the face of the barrier and the top edge of the backup diaphragm at 32” above ground level, see Figure 9. Remember, when installing the QuadGuard System that the correct transition panel offset must be achieved in order for the offset bracket to nest between the barrier and transition panel ensuring proper performance of the transition.

Figure 9
Transition Panel Offset

Left Side Application

Right Side Application
Transition Panel Types

If a system is placed in a location where traffic will be approaching from the rear, a transition panel is necessary. Figures 5, 6, 7 & 8 show the standard panel types. There are variations for each panel type. The specific panel needed will depend on system and site conditions. Therefore, it is important to send site specific data to the customer service department for a recommendation for exact panel needed for your application.
Site Preparation

Establish Required System Footing
Note that the system must be anchored. MP-3 polyester anchor bolts will be supplied for all required anchorages in concrete. Refer to QuadGuard® Installation Manual, or MP-3 kits for detailed installation instructions.

1) Is the system to be placed on existing concrete?
   - **Existing concrete** - Concrete must be at least 150 mm [6"] thick, reinforced 28 MPa [4000 psi] Portland cement concrete (P.C.C.), or 200 mm [8"] thick non-reinforced 28 MPa [4000 psi] P.C. Concrete Roadway, measuring at least 3.66 m [12'-0"] wide by 15.24 m [50'-0"] long. The concrete should be in good condition and be free of major cracks.
   - **New concrete** - If existing concrete does not meet these criteria, a new concrete pad must be placed to properly secure the system. See concrete pad details supplied with the system.

2) Is there a cross slope at the installation site?
   - **Cross slope exists** - If there is a cross slope of more than 8% (5 deg.), or if the cross slope varies (twists) more than 2% (1 deg.) over the length of the system, a concrete leveling pad may be required. (See Figure 4)
   - **No Cross slope** - No additional action is required.

![Figure 4](Cross-Slope)

General Maintenance and Repair

The QuadGuard System is considered to be reusable. After most design impacts, you can expect to reuse 65 - 70% of the system. The system must be inspected after each impact and must be pulled out to its original length. Depending on the impact, components may get damaged and need replacement.

**Estimated time for Maintenance**
An experienced two person crew with the proper tools and spare parts should be able to complete the work in one to 3 hours depending on the damage done to the system.

**Life Expectancy**

**Environment**
Except due to impact damage, it is anticipated that the cartridges will survive in a highway environment for a period ranging from 10 to 15 years from the date of installation.

**Impacts**
Life expectancy is also dependent on the impacts. This includes:
1. The number of impacts
2. The severity of the impacts
3. The temperature at the time of the impacts

Systems must be inspected after each impact. Any cartridge that is crushed or otherwise damaged should be replaced and the system should be pulled out to its original length.

**IMPORTANT:** After an impact, always follow the “Post-Impact Instructions” in the maintenance and repair section of the installation manual.

**Recycling Information**
When parts need to be replaced, it is recommended that the old parts be recycled as follows:

Steel should be sold as scrap to a local metal recycler.

Plastic from the cartridges should be sold to a plastic recycler if available. If a recycler is unavailable, dispose of the material as plastic refuse.

The 6 bay 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. These tests typically evaluate product performance by closely simulating actual impacts involving a typical range of vehicles on roadways, from lightweight cars (approx. 820 kg [1800 lb.]) to full size pickup trucks (approx. 2000 kg [4400 lb.]). A product can be certified for various speed levels.

- TL-1: 50 km/h [31.10 mph]
- TL-2: 70 km/h [43.49 mph]
- TL-3: 100 km/h [62.13 mph]

These tests are not designed to represent the performance of products when impacted by every vehicle type or every impact condition.

Energy Absorption Systems, Inc. does not represent nor warrant that the results of these controlled tests show that vehicle impacts with the products in other conditions would necessarily avoid injury to person(s) or property. Impacts that exceed the design capabilities of the product may not result in acceptable crash performance as outlined in NCHRP Report 350, relative to structural adequacy, occupant risk and vehicle trajectory. Energy Absorption Systems, Inc. expressly disclaims any warranty or liability for injury or damage to persons or property resulting from any impact, collision, or harmful contact with products, other vehicles, or nearby hazards or objects by any vehicle, object or person, whether or not the products were installed by or under the direction of Energy Absorption Systems, Inc. or by third parties.

Impact conditions which differ from those described in NCHRP 350 test matrix 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 (at the site of the installation) of curbs or cross slopes in excess of 8% may yield crash performance which does not meet NCHRP 350 evaluation criteria relative to structural adequacy, occupant risk and vehicle trajectory factors.

The QuadGuard System was designed to be installed, delineated, and maintained in accordance with State and Federal guidelines. It is important to select the most appropriate product configuration for a site. The customer should be careful to properly select, install and maintain the product. Careful evaluation of the site geometry, vehicle population type, speed, traffic direction and visibility are some of the elements that require evaluation in the proper selection of a safety appurtenance. For example, curbs could cause unsafe vehicle trajectory.

After an impact occurs, the product should be restored to its original condition as soon as possible. When a reusable safety product is struck, it is still necessary to restore the product to its original length and inspect all the components for damage and repair and/or replace components as necessary.

*Copy may be obtained from:
Transportation Research Board
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418
NOTES:
1. UNDERLYING PANEL IS EITHER ANOTHER FENDER PANEL OR, IN THE CASE OF THE LAST FENDER PANEL, IT COULD BE A BACKUP SIDE PANEL, EXTENSION PANEL OR TRANSITION PANEL.
2. UNITS OF MEASUREMENT ARE IN MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.

CAUTION
20 [0.79] MAX. FOR PROPER IMPACT PERFORMANCE.

PLAN
SCALE = 1:8

USE A 3/8" ALLEN WRENCH DURING THE ASSEMBLY PROCESS.

THE SPRING (ITEM 8) SHOULD BE COMPRESSED 1 TO 3 MM (1/16" TO 1/8") TO COMPLETE THE ASSEMBLY.

ASSEMBLY NO. 3540040–0000

QUADGUARD® SYSTEM
FENDER PANEL ASSY, QG

Revisions
Date
Rev.
Okl/App.
CORRECTED DIAPHRAGM SPACING 11/26/96 C RGC

DIAPHRAGM SPACING FRONT TO FRONT 11/26/96 H DWM AWE CMY

8 WAS 202/81–200; 7 QTY WAS 4.0 4/12/94 1 OR AWE KC


energy absorption systems, Inc.
engineering and research department
quadguard® system
fender panel assy, qg

references

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<th>Description</th>
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<th>Notes</th>
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Two fender panel assemblies required per bay.
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**NOT APPLICABLE FOR 90° & 90° OR CZ QG SYSTEMS**

**NOT APPLICABLE FOR CZ QG SYSTEMS**

---

**PARTS LIST**

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**NOTES**

1. Use MONORAIL(S) (ITEM 1, 2, AND 3) AS TEMPLATE(S) TO LOCATE MP-3 ANCHOR BOLTS (ITEM 5). SEE SHEET 2.
2. CROSS SLOPE OF PAD SHALL NOT EXCEED 5% & NOT VARY MORE THAN 2% FROM FRONT TO BACK.
3. UNITS OF MEASUREMENT ARE MILLIMETERS (INCHES) UNLESS OTHERWISE NOTED.
4. MONORAIL MUST BE EMBEDDED TO A DEPTH OF 140 (5.50) IF REPAIR IS ENCOUNTERED IN A P.C. CONCRETE PAD, DRILL THROUGH IT. IF REPAIR IS ENCOUNTERED ON A DECK STRUCTURE, ASK PROJECT ENGINEER FOR DIRECTION.
5. FOR CZ SYSTEMS, SEE DRAWING 35-40-24 ALSO.

**ASSEMBLY NO.**

**ENERGY ABSORPTION SYSTEMS, INC.**

**QUADGUARD® SYSTEM**

**MONORAIL ASSY, QG**

---

**SHEET NO.**

**DRAWN BY:**

**DATE:** 3-8-96

**N. F. S.**

---

**DRAWN BY:**

**DATE:** 3-1-96

---

**DRAWN BY:**

**DATE:** 5-17-96

---

**DRAWN BY:**

**DATE:** 5-17-96

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**DRAWN BY:**

**DATE:** 5-17-96

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**DRAWN BY:**

**DATE:** 5-17-96
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### Section A-A

1. Cross slope of pad shall not exceed 1:3:1 and not vary more than 2% from front to back.
2. Units of measurement are kilometers unless otherwise noted.

### Section B-B

- 28 MPA (4000 psi) minimum, p.c. concrete pad and anchor block: 2204 kg/m³ [145 lb/ft³].

### Section C-C

- 76 [2.00] ft concrete pad.

### Section D-D

- 76 [2.00] ft concrete pad.
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 105Nm [77 FT-LBS] (TYP).
   ANCHOR STUD END SHOULD BE FLUSH WITH OUTSIDE SURFACE OF ANCHOR NUT.
3. CONCRETE BACKUP SHOWN, TENSION STRUT SIMILAR.
4. GRACE IS NOT REQUIRED WITH END SHOE ATTACHMENT.

REFERENCES

ASSY. NO. WAS 3540151-0000 800/600 A RH 83 87 1/2 FT
QuadGuard® System

Parts List

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System Notes:

1. All dimensions shown are for reference only. Actual dimensions shall be determined by the manufacturer.
2. All parts are standard unless otherwise noted.
3. All notes and dimensions are in accordance with the scale shown on the drawing.
4. All parts are included in the parts list.

Detail A

- Final connection of diagonal bracing for maximum seismic isolation.
- 3/8" flat washer and lock nut.
- 1/4" locknut and washers.
- 1/4" locknut and washers.

Detail B

- Posts and connectors as noted.
- Refer to notes 2 and 3.

Diagram Notes:

1. Dimensions are in accordance with the drawing.
2. All parts are standard unless otherwise noted.
3. All notes and dimensions are in accordance with the scale shown on the drawing.
4. All parts are included in the parts list.

Transition Assembly

- Quad-beam to three-beam

Date: 3/23/06

Energy Absorption Systems, Inc.
Engineering and Design Department

Person: [Signature]

Date: 3/23/06

Maintenance and Service Manual

Persons Name: [Signature]

Date: 3/23/06

Figure: 1

[Diagram of QuadGuard® System with dimensions and notes]
QuadGuard® System

**Detail A**

6 BAY QuadGuard cz
SCALE = 1:30

**CAUTION:**
To avoid injury, never stand beneath lifted components.

**TO MOVE SYSTEM IN 3 BAY SECTIONS:**
1. Remove cartridge from bays that have a monorail bolt connecting sections together below them.
2. Remove mushroom bolts for the bay that has had the cartridge removed. This will become the break point for the QuadGuard system.
3. Remove all anchor bolts.
4. Remove monorail bolts that connect sections together.
5. Lift only one 3 BAY section at a time. Start with nose section first.
6. Place slings through the lifting loops on each corner of the plate. The sling needs to be a minimum of 9 feet long to each lifting loop. Make sure that the sling is long enough that the angle is less than 60° as shown.
7. Lift unit from anchors prior to lifting the system to accomplish this. Start at the nose of the system and use four bars to gradually raise the system off of the anchors. Place blocks such as 2x4s under the anchor plates and work down the length of the unit. Until the unit is completely free of the anchors.
8. Install the end plate (item 12) on endcap (item 11) on each 3 BAY section of the monorail as shown (item 13 not needed for the backup section). If the total unit has 7 or more bays, both the endcap and end plate will need to be moved to the section that is being lifted to prevent the slippers from sliding off the monorail.
9. Lift the system to new location, remove end plate(s) and re-install system.

**TO MOVE 6 TO 9 BAY SYSTEM ASSEMBLED:**
1. Remove all anchor nuts and bolts.
2. Attach a four point sling to each plate, place sling through the lifting loops located on each corner of the plate. See detail A
3. Fire unit from anchors prior to lifting the system to accomplish this. Start at the nose of the system and use four bars to gradually raise the system off of the anchors. Place blocks such as 2x4s under the anchor plates and work down the length of the unit until the unit is completely free of the anchors.
4. Lift unit to new location and attach slings to multiple spread lifting. Bar ream and adjust sling positions as needed in order to balance the system.
5. Re-install.

**Parts List**

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<td>840220-0000</td>
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<td>5</td>
<td>270406-0000</td>
<td>END CAP MONORAIL 012,0</td>
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<td>270402-0000</td>
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**Assembly No.:** 3540233-0000

**Notes:**
- See chart
- Energy Absorption Systems, Inc.
- Engineering and Special Equipment
- QuadGuard® System
- Az on a plate 0.56
- Lifting kit & instructions

**Revisions:**
- L. Cooker 03/21/03
- R. Breuer 03/17/03
- R. M. Hensley 03/29/03
- R. Breuer 03/29/03

**Checked:**
- R. Breuer 03/29/03

**Form:**
- AS NOTE 35-40-23
- 1 of 1

**Engineered Product Design:**
- 35-40-23
NOTE:
1. THE REINFORCEMENT SHOWN IN DETAIL "A" IS RECOMMENDED FOR PORTABLE CONCRETE BARRIER TO ENSURE ADEQUATE BARRIER INTEGRITY WHEN USED IN COMBINATION WITH THE QUADGUARD® SYSTEM. THE DETAIL SHOWN IS BASED ON STATE OF CALIFORNIA STANDARD PLANS FOR TEMPORARY RAILING (TYPE K). VARIATIONS MAY BE REQUIRED AND DETERMINATIONS MADE AS TO REASONABLE EQUIVALENCE BY PROJECT ENGINEER.
2. USE ANCHOR PLATE AS TEMPLATE FOR DRILLING.
3. RECOMMENDED HOLE DEPTH INTO PCBMB IS 1 1/2 (3.00). DRILL 4 HOLES IF NECESSARY TO INSTALL A MINIMUM OF 2 ANCHOR BOLTS PER BRACKET. FINAL TORQUE TO BE 30 KUX(120 ft-lb) (TYP).
4. IMPACT FORCES CAN BE TRANSFERRED INTO TYPICAL END OF THE BARRIER. ADEQUATE ANCHORAGE IS REQUIRED TO ENSURE PROPER IMPACT PERFORMANCE. PCBMS MUST BE ANCHORED TO A RIGID SURFACE (NOT DIRT) WITH A MINIMUM OF 12 THREADED RODS (ITEM 3) AS SHOWN. ANCHOR BOTH SIDES OF BARRIER USING ITEM 1 (8 REQUIRED). ATTACH PCBMS USING ONE OF THE FOLLOWING:
   1. 1/2" STUDS MAY BE USED TO ANCHOR PCBMS TO 28 MPA (4000 PSI) MIN.
   2. CONCRETE PER THE FOLLOWING MINIMUM CONCRETE DEPTHS:
      a) 150 (6.00) NON-REINFORCED ROADWAY.
      b) 180 (7.00) DECK STRUCTURE.
   3. 1/2" THREADED RODS MAY BE USED TO ANCHOR PCBMS TO ASPHALT, (6" MIN. THERM.
5. MIN. 28 MPA (4000 PSI) P.C. CONCRETE MEDIAN BARRIER.
6. DIMENSIONS ARE IN MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.

**REFER TO THE QUADGUARD CZ MP-3 ANCHORING SYSTEM INSTALLATION INSTRUCTIONS FOR SPECIFICATIONS.**
QuadGuard® System

**Top View**

- Item 4 attaches to panel, only if it is not anchored into the barrier.
- Single slope concrete barrier.

**Section A-A**

- Item 1 will replace backup side panel.
- Use this hole for mushroom bolt installation. (See fender panel assy)

**Left Side View**

- Single slope concrete barrier.
- Mechanical type anchors may be substituted in horizontal applications and shall be supplied by others. The substituted anchors shall be the same diameter as the MP-3 anchors and shall have the following minimum pullout strengths:
  - 10 [0.35] Dia.: 12KN (2760 lbs)
  - 20 [0.75] Dia.: 50KN (11,000 lbs)

**Front View**

- Single slope concrete barrier.

**Right Side View**

- Use this hole for mushroom bolt installation. (See fender panel assy)

---

**Parts List**

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**Application**

- LEFT SIDE: 304033L-0000 276041-0000
- RIGHT SIDE: 304033R-0000 276042-0000

**Assembly No.** See Table

---

**Energy Absorption Systems, Inc.**

**Engineering and Research Department**

**QuadGuard™ System**

**Transition Panel Installation for Single Slope Barrier**

**References**

- Material:
  - a. Angled A
  - b. Linear A
  - (Unless Otherwise Noted)

**Next Assembly**

- 3/4"=1'-0"
- 35/40-33
- B
**Notes:**

1. **Underlying Panel** is a fender panel if attached to a diaphragm. Underlying Panel is a backup side panel, extension panel, or transition panel if attached to the backup.

2. Units of measurement are millimeters (inches) unless otherwise noted.

3. Tighten nut until it reaches end of threads.
QuadGuard® System

TABLE L (SEE NOTE 2)

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NOTES:
1. CROSS SLOPE OF PAD SHALL NOT EXCEED 3% AND NOT VARY MORE THAN 2% FROM FRONT TO BACK.
2. ALL CONCRETE TO BE 28MPA [4000 PSI] F/C CONCRETE.
3. FOR EXISTING APPROVED CONCRETE SURFACES:
   a) MIN 150 [5"] DECK STRUCTURE.
   b) MIN 200 [8"] NON-REINFORCED ROADWAY MEASURING AT LEAST 3.6 M [12-0"] WIDE BY 10.24 M [35-0"] LONG OR
   c) MIN 150 [5"] REINFORCED PAD.
   VERTICAL STEEL SHALL BE DOWELLED 140 [5-3"] MIN. USING NP-3 ANCHORING SYSTEM GROUT OR EQUAL, ADJUST REBAR AND CONCRETE QUANTITIES AS NECESSARY.
4. PAD AND BELOW GRADE ANCHOR BLOCK TO BE POURED MONOLITHICALLY.
5. A WIDTH OF 76 [3"] IS REQUIRED IF AN END SHOE IS TO BE USED.
6. DIMENSIONS ARE IN MM [IN] UNLESS OTHERWISE NOTED.

SEE SHEETS 2 OR 3 FOR BACKUP

PLANT VIEW

SECTION A-A

REFERENCES

D. Strauss 7/25/97
J. Methods 9/19/97
E. Colley 8/16/97
S. S. Colley 7/24/97

CONCRETE PAD & BACKUP, QG WIDE

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT
QUADGUARD® SYSTEM

REVISION HISTORY

REVISED SHEETS 2 & 3 8/24/97 9/19/97
DRAWING SHEETS 2 & 3 8/24/97 9/19/97
DRAWING SHEETS 2 & 3 2/7/99 6/30/99
DRAFT SHEETS 2 & 3 2/7/99 6/30/99
CIVIL SHEETS 2 & 3 2/7/99 6/30/99

1:30 3540411-0000

1 of 3

G

51
QuadGuard® System

Diagram of a reinforced concrete barrier system with detailed instructions and notes.

Table - Item 1

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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 MAXIMUM IMPACT OF 25,000 LBS (11,300 KG) 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 PLUGGED WITH OUTSIDE SURFACE OF ANCHOR NUT. SEE DETAIL B.
5. MIN. 27.6 MPA [4000 PSI] P.C. CONCRETE MEAN BARRIER.
6. BACKUP SIDE PLATE FOR 49" wide system to be offset (6") from side of barrier @ 910,000 ft-lbs above grade. FOR 58" wide system there would be no offset.
7. GRACE NOT REQUIRED WITH OFFSET TRANSITION.

REFERENCES

QuadGuard® System

Energies Absorption Systems, Inc.
Engineering and Research Department

Quarter Guard System Transition Assy, 4 Offset, 0.69/90

Revision History

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QuadGuard® System

LEFT SIDE APPLICATION

5/8x2 RAIL BOLT
(SEE BACKUP ASSY)

RIGHT SIDE APPLICATION

5/8x2 RAIL BOLT
(SEE BACKUP ASSY)

NOTES:
1. USE TRANSITION PANEL AS TEMPLATE FOR DRILLING.
2. IMPACT FORCES MIGHT BE TRANSFERRED INTO TERMINAL END OF THE BARRIER. ADEQUATE ANCHORAGE IS REQUIRED FOR PROPER IMPACT PERFORMANCE.
3. ANCHOR STUD END SHOULD BE PLUG WITH OUTSIDE SURFACE OF ANCHOR NUT, SEE DETAIL B.

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<td>2706031-0000</td>
<td>WASHER FLAT #10.5X1 3/4L</td>
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<td>BELT NOSE QUADGUARD, PARALLEL</td>
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<td>CARTRIDGE SUPPORT LES BRACKET, ADJUSTABLE</td>
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### Table

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**Reference**

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<th>Item</th>
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<td>D. Staus</td>
<td>12/26/98</td>
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**Assembly No.**

QuadGuard® System
Nose Assy, QG, 24, 30, 36, Also QG CZ on a Plate, W/Belting

**Energy Absorption Systems, Inc.**
Engineering and Research Department
QUADGUARD® System

58

QuadGuard® System

CROSS SLOPE DETAIL
SCALE = 1:1

ANCHOR SYSTEM:
1. CROSS SLOPE OF PLATE SHALL NOT EXCEED 8% AND NOT VARY MORE THAN 2% FROM FRONT TO BACK.
2. USE THE ANCHOR PLATES AS A TEMPLATE FOR DRILLING HOLES. HOLES LOCATIONS ARE GIVEN ON SHEETS 2 AND 3 FOR REFERENCE PURPOSES ONLY.
3. USE MP-3 POLYMER ANCHOR SYSTEM SUPPLIED BY ENERGY ABSORPTION SYSTEMS, OR APPROVED EQUAL. QUADGUARD® SYSTEMS INSTALLED ON ASSEMBLY MUST BE INSPECTED TO ENSURE THE ANCHORS ARE PROPERLY SET FOLLOWING EACH IMPACT. RE-ANCHOR AS NECESSARY.
4. EVERY HOLE IN THE BACKUP PLATE AND ADAPTER PLATE(S) MUST HAVE AN MP-3 STUD ANCHORING IT, EXCEPT AS NOTED ON SHEETS 2 & 3.

ASSEMBLY NO. 354084*-0000

R. Carruthers 12/18/04
R. Broucher 12/17/01
J. Esquivel 11/09/04
D. Franklin 12/29/04
S. Thompson 12/31/04

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING & SPECIAL EQUIPMENT

CZ ON A PLATE/MP-3 ANCHOR KIT, .G. 3 BAY B/U, 3 BAY ADAPTER PLATES
Customer Service Department

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