Important: These instructions are to be used only in conjunction with the assembly, maintenance, and repair of the specified QuadGuard® II system. These instructions are for standard assembly specified by the appropriate highway authority only. In the event the specified system assembly, maintenance, or repair would require a deviation from standard assembly parameters, contact the appropriate highway authority engineer. This system has been accepted by the Federal Highway Administration for use on the national highway system under strict criteria utilized by that agency. Energy Absorption Systems representatives are available for consultation if required.

This Manual must be available to the worker overseeing and/or assembling the product at all times. For additional copies, contact Energy Absorption Systems at (888) 323-6374 or download from websites below.

The instructions contained in this Manual supersede all previous information and Manuals. All information, illustrations, and specifications in this Manual are based on the latest QuadGuard® II system information available to Energy Absorption Systems at the time of printing. We reserve the right to make changes at any time. Please contact Energy Absorption Systems to confirm that you are referring to the most current instructions.
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Customer Service Contacts

Energy Absorption Systems (a Trinity Highway Products company) is committed to the highest level of customer service. Feedback regarding the QuadGuard® II system, its assembly procedures, supporting documentation, and performance is always welcome. Additional information can be obtained from the contact information below:

Energy Absorption Systems:

| Telephone:         | (888) 323-6374 (USA Only)  
          | (214) 589-8140 (USA or International) |
|-------------------|--------------------------------------|
| E-mail:           | customerservice@energyabsorption.com |
| Internet: Energy Absorption Systems  
       Trinity Highway Products, LLC | http://www.energyabsorption.com  
          http://www.highwayguardrail.com |

Important Introductory Notes

Proper assembly of the QuadGuard® II is essential to achieve performance of the system under appropriate federal and state criteria. These instructions should be read in their entirety and understood before assembling the QuadGuard® II. These instructions are to be used only in conjunction with the assembly of the QuadGuard® II and are for standard assemblies only as specified by the applicable highway authority. In the event your system assembly requires or involves deviation from standard parameters or, during the assembly process a question arises, please contact the appropriate highway authority that specified this system at this particular location for guidance. Energy Absorption Systems is available for consultation with that agency. These instructions are intended for an individual who is qualified to both read and accurately interpret them as written. They are intended for the individual who is experienced and skilled in the assembly of highway products which are specified and selected by the highway authority.

A set of product and project shop drawings will be supplied by Energy Absorption Systems. The shop drawings will be for each section of the assembly. These drawings should be reviewed and studied thoroughly by a qualified individual who is skilled in interpreting them before the start of any assembly.
Important: Read safety instructions thoroughly and follow the assembly directions and suggested safe practices before assembling, maintaining, or repairing QuadGuard® II system. Failure to follow this warning can result in serious injury or death to workers and/or bystanders. It further compromises the acceptance of this system by the FHWA. Please keep these instructions for later use.

Warning: Ensure that all of the QuadGuard® II system Warnings, Cautions, and Important Statements within the QuadGuard® II Manual are completely followed. Failure to follow this warning could result in serious injury or death in the event of a collision.

Recommended Safety Rules for Assembly

* Important Safety Instructions *
This Manual must be kept in a location where it is readily available to persons who assemble, maintain, or repair the QuadGuard® II system. Additional copies of this Manual are immediately available from Energy Absorption Systems by calling (888) 323-6374. Please contact Energy Absorption Systems if you have any questions concerning the information in this Manual or about the QuadGuard® II system. This Manual may also be downloaded directly from the websites indicated below.

Always use appropriate safety precautions when operating power equipment, mixing chemicals, moving heavy equipment or QuadGuard® II components. Gloves, safety goggles, steel toe boots, and back protection should be used.

Safety measures incorporating traffic control devices specified by the highway authority must be used to provide safety for personnel while at the assembly, maintenance, or repair site.
Safety Symbols
This section describes the safety symbols that appear in this QuadGuard® II Manual. Read the Manual for complete safety, assembly, operating, maintenance, repair, and service information.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Safety Alert Symbol" /></td>
<td>Safety Alert Symbol: Indicates Danger, Warning, or Caution. Failure to read and follow the Danger, Warning, Safety, or Caution indicators could result in serious injury or death to the workers and/or bystanders.</td>
</tr>
</tbody>
</table>

Warning and Cautions
Read all instructions before assembling, maintaining, or repairing the QuadGuard® II system.

**Warning:** Do not assemble, maintain, or repair the QuadGuard® II system until you have read this Manual thoroughly and completely understand it. Ensure that all Warnings, Cautions and Important statements within the Manual are completely followed. Please call Energy Absorption Systems at (888) 323-6374 if you do not understand these instructions. Failure to follow this warning could result in serious injury or death in the event of a collision.

**Warning:** Safety measures incorporating appropriate traffic control devices specified by the highway authority must be used to protect all personnel while at the assembly, maintenance or repair site. Failure to follow this warning could result in serious injury or death in the event of a collision.

**Warning:** Use only Energy Absorption Systems parts that are specified herein for the QuadGuard® II for assembling, maintaining or repairing QuadGuard® II system. Do not utilize or otherwise comingle parts from other systems, even if those systems are other Energy Absorption Systems or Trinity Highway Products systems. Such configurations have not been tested nor have they been accepted for use. Assembly, maintenance or repairs using unspecified parts or accessories is strictly prohibited. Failure to follow this warning could result in serious injury or death in the event of a vehicle impact with an UNACCEPTED system.

**Warning:** Do NOT modify the QuadGuard® II system in any way. Failure to follow this warning could result in serious injury or death in the event of a collision.

**Warning:** Ensure that the QuadGuard® II system and delineation used meet all federal, state, specifying agency, and local specifications. Failure to follow this warning could result in serious injury or death in the event of a collision.

**Warning:** Ensure that your assembly meets all appropriate Manual on Uniform Traffic Control Devices (MUTCD) and local standards. Failure to follow this warning could result in serious injury or death in the event of a collision.
Limitations and Warnings

Energy Absorption Systems, in compliance with the National Cooperative Research Highway Program 350 (NCHRP Report 350) “Recommended Procedures for the Safety Performance of Highway Safety Features”, contracts with FHWA approved testing facilities to perform crash tests, evaluation of tests, and submittal of results to the Federal Highway Administration for review.

The QuadGuard® II system has been approved by FHWA as meeting the requirements and guidelines of NCHRP Report 350* TL-1 (2 Bay system), TL-2 (2 Bay system) and TL-3 (5 Bay system). These tests, typically evaluate product performance by closely simulating actual impacts involving a typical range of vehicles on our roadways, from lightweight cars (approx. 820kg [1800 lb.]) to full size pickup trucks (approx. 2000 kg [4400 lb.]) as specified by the FHWA. A product can be certified for multiple Test Levels. The QuadGuard® II is certified to the Test Level(s) as shown below:

Test Level 1: 50 km/h [31 mph]
Test Level 2: 70 km/h [44 mph]
Test Level 3: 100 km/h [62 mph]

These FHWA directed tests are not intended to represent the performance of systems when impacted by every vehicle type or every impact condition existing on the roadway. This system is tested only to the test matrix criteria of NCHRP 350 as approved by FHWA.

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

Energy Absorption Systems 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 criteria capabilities of the product may not result in acceptable impact performance as outlined in NCHRP Report 350, relative to structural adequacy, occupant risk, and vehicle trajectory. Energy Absorption Systems 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 assembled by or in the presence of Energy Absorption Systems representatives or by third parties.

The QuadGuard® II system is intended to be assembled, delineated, and maintained in accordance with specific 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, assemble 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 an untested effect on an impacting vehicle.

After an impact occurs, the product should be restored to its original condition as soon as possible. When a potentially reusable safety product is impacted, it is still necessary to restore the product to its original length and inspect all the components as necessary.
**System Overview**

The QuadGuard® II is a potentially reusable, redirective, non-gating crash cushion for hazards ranging in width from 610 mm to 2285 mm (24" to 120"). It consists of energy-absorbing Cartridges surrounded by a framework of Quad-Beam™ panels.

The QuadGuard® II 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.

**Impact Performance**

The 5 Bay QuadGuard® II systems have successfully passed the requirements stipulated in NCHRP Report 350, Test Level 3 tests with both the light car and pickup at speeds of up to 100 km/h [62 mph] at angles up to 20 degrees.

During head-on impacts within NCHRP Report 350 criteria, the QuadGuard® II telescopes rearward and crushes the Cartridges to absorb the energy of impact. When impacted from the side, under those same 350 criteria, crash testing showed that it safely redirects the vehicle back toward its original travel path and away from the hazard.
How to Determine Left/Right
To determine left from right when ordering parts, stand in front of the system facing the hazard. 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, two Fender Panels, etc. 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). Five Bay system shown.

Figure 1
System Orientation
Measuring the Width

The QuadGuard® II system is available in seven nominal widths:

- 610 mm [24”]
- 760 mm [30”]
- 915 mm [36”]
- 1219 mm [48”]
- 1755 mm [69”] (Minimum 3 Bays Required)
- 2285 mm [90”] (Minimum 6 Bays Required)
- 3200 mm [126”]

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.

![Figure 2](image1.png)

**Figure 2**
Width of system with Tension Strut Backup

![Figure 3](image2.png)

**Figure 3**
Width of system with Concrete Backup
QuadGuard® II Deployment Criteria

Contact Energy Absorption Systems Customer Service Department if you would like input as to your specific application. Proper model selection is essential to the performance of the QuadGuard® II system. You will need to answer the following questions:

1) **Specification of System Width**

   The QuadGuard® II system is available in seven nominal widths:
   
   - 610 mm [24”]
   - 760 mm [30”]
   - 915 mm [36”]
   - 1219 mm [48”]
   - 1755 mm [69”]
   - 2285 mm [90”]
   - 3200 mm [126”] Minimum 6 Bays required

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

2) **Specify 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.

3) **Specify Foundation**

   Note that the system must be anchored. MP-3® polyester anchor bolts will be supplied for all required anchorages in concrete. Refer to QuadGuard® II Assembly Manual or MP-3® kits for detailed assembly instructions.

   A. **Is the system to be placed on existing concrete?**

   **Existing concrete** – Concrete must be at least 150 mm [6"] thick, reinforced 28 MPa [4000psi] 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, then a new concrete pad must be placed to properly secure the system. See concrete pad details supplied with the system.
B. Is there a cross-slope at the construction site?

Cross-slope exists – If there is a cross-slope of more than 8% (5 degrees), or if the cross-slope varies (twists) more than 2% (1 degree) over the length of the system, a concrete leveling pad may be required (See Figure 4).

No cross-slope – No additional action is required.

4) Specify Backup Structure

The two Backup designs available are the Tension Strut Backup and the Concrete Backup. Both types are appropriate for use on grade or deck.

5) Special Site Conditions

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

1. Are curbs, islands or elevated objects (delineators or signs) present at the site? What height and width are they? All curbs and elevated objects over 100 mm [4"] high should be removed. If possible, curbs taller than 100 mm [4"] high should be removed approximately 15 m [50'] in front of the QuadGuard® II systems 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 construction 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 at least 150 m [500'] in front, so traffic patterns can be visualized?

4. Is there an existing barrier? Where there is an existing guardrail or median barrier at the site, the Backup of the QuadGuard® II 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 crossover traffic is a concern? If so, a Transition from the back of the system to the hazard is necessary to prevent vehicle interaction (See Page 20).

6. Are there any other unique features at the site that may affect positioning or performance of the QuadGuard® II system?
6) Other Factors that May Affect Your Deployment:

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 Service Department before proceeding with your design (See Page 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 assembly) of curbs or cross-slopes in excess of 8%, may yield performance which does not meet NCHRP 350 evaluation criteria relative to structural adequacy, occupant risk and vehicle trajectory factors.

![Model Number Description Diagram](image)

**Figure 5**

*Model Number Key*
These following charts represent the modified versions of the QG II length relative to impact speed, which is based on the capacity of the system using a 2000 kg [4400 lb] pickup truck.

**Table A – Speed Chart For Narrow Systems**

<table>
<thead>
<tr>
<th># of Bays</th>
<th>Model #</th>
<th>Vehicle Speed kph [mph]</th>
<th>Type I Cartridge Qty.</th>
<th>Type II Cartridge Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1*</td>
<td>QG 240_ _</td>
<td>40 [25]</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>QG 270_ _</td>
<td>70 [44]</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3*</td>
<td>QG 280_ _</td>
<td>80 [50]</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4*</td>
<td>QG 290_ _</td>
<td>90 [56]</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>QG 2100__</td>
<td>100 [62]</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6*</td>
<td>QG 2105__</td>
<td>105 [65]</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>7*</td>
<td>QG 2110__</td>
<td>110 [68]</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>8*</td>
<td>QG 2115__</td>
<td>115 [71]</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9*</td>
<td>QG 2120__</td>
<td>120 [75]</td>
<td>4</td>
<td>6</td>
</tr>
</tbody>
</table>

*System capacity estimated through calculation.

**Table B – Speed Chart For Wide Systems**

<table>
<thead>
<tr>
<th># of Bays</th>
<th>Model #</th>
<th>Vehicle Speed kph [mph]</th>
<th>Type I Cartridge Qty.</th>
<th>Type II Cartridge Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3*</td>
<td>QG 270_ _</td>
<td>70 [44]</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4*</td>
<td>QG 280_ _</td>
<td>80 [50]</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5*</td>
<td>QG 2100__</td>
<td>100 [62]</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6*</td>
<td>QG 2105__</td>
<td>105 [65]</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>7*</td>
<td>QG 2110__</td>
<td>110 [68]</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>8*</td>
<td>QG 2115__</td>
<td>115 [71]</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9*</td>
<td>QG 2120__</td>
<td>120 [75]</td>
<td>4</td>
<td>6</td>
</tr>
</tbody>
</table>
QUADGUARD® II SYSTEM
FOR NARROW HAZARDS

3200 [126"] MODEL NO. QG210024
760 mm [30"] MODEL NO. QG210030
915 mm [36"] MODEL NO. QG210036
1219 mm [48"] MODEL NO. QG210048

QUADGUARD® II SYSTEM
FOR WIDE HAZARDS

1755 mm [69"] MODEL NO. QG210069
5.83 m [19'-1”]

2285 MM [90’”] MODEL NO. QG210090
8.73 M [22'-1”]

3200 [126"] MODEL NO. QG2100126 (Min. 6 Bays required)

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

Figure 6
Plan & Elevation
(5 Bay system with Tension Strut Backup shown)
Transitioning

Quad-Beam™ End Shoe Transition Panel
The Quad-Beam™ End Shoe Panel transitions the QuadGuard® II system to vertical faced concrete structures whether it is a concrete Backup or concrete barrier wall (See Page 20). 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 interaction.

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® II system to new and existing runs of standard guardrail (See Page 16).

Quad-Beam™ to Safety Barrier Transition Panel
There are several options available when transitioning the QuadGuard® II 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 16). For transitioning to barriers that are in line with the side of the system, use transition assembly 616041B or 616044B. For transitioning a wide system to barrier that runs parallel to the centerline of the system, transition assembly 616048B or 616049B 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 the 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?
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 7). Remember, when assembling the QuadGuard® II 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 7 Transition Panel Offset](image-url)
Transition Panel Types

If a system is placed in a location where traffic will be approaching from the rear, a Transition Panel is necessary. Figure 8, 9, 10 and 11 show standard panel types. There are variations for each panel type. The specific panel applied 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 requirements of your application.

Figure 8
Quad-Beam™ to Safety Barrier (NJ shape) Transition Panel

Figure 9
Quad-Beam™ to Thrie-Beam Transition Panel

Figure 10
Quad-Beam™ to W-Beam Transition Panel

Figure 11
Quad-Beam™ End Shoe Transition Panel
QuadGuard® II cz Deployment Criteria

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

The QuadGuard® II cz must be properly anchored (See Pages 15 and 16 for the recommended anchorage of various foundations).

Table C
QuadGuard® II cz Plate Model Numbers

<table>
<thead>
<tr>
<th>Number of Bays</th>
<th>NOMINAL WIDTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>610 MM [24&quot;]</td>
</tr>
<tr>
<td>2</td>
<td>QZ27024P</td>
</tr>
<tr>
<td>5</td>
<td>QZ210024P</td>
</tr>
</tbody>
</table>

Model Number Description

![Diagram of QuadGuard II CZ (Construction Zone) with design speed and plate/monorail sections]

Figure 12
Model Number Key

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www.highwayguardrail.com
Revision F December 2012
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QuadGuard® II Foundation/Anchoring

Concrete Installations

For concrete installations, the QuadGuard® II system should be installed only on an existing or freshly placed and cured concrete base (28 MPa [4000 psi] minimum). Orientation of the concrete base and the attenuator must comply with the project plans or as otherwise determined by the resident project engineer or appropriate highway authority.

Recommended dimension and reinforcement specifications for new concrete pads can be found on the standard drawings.

Asphalt Installations

For asphalt installations in construction zones, QuadGuard® II system may only be assembled with a Tension-Strut Backup. Assemblies on asphalt must provide a minimum of 76 mm [3"] layer of asphalt over a minimum of 76 mm [3"] layer of Portland Cement concrete, 152 mm [6"] layer of asphalt over 152 mm [6"] layer of subbase, or 203 mm [8"] layer of asphalt with no subbase. 460 mm [18"] threaded rods, installed with the two-part MP-3® grout, must be used for these foundations.

Important: Systems mounted on asphalt must be replaced and mounted on fresh, undisturbed asphalt if more than 10% of anchors are found to be loose, broken, or show signs of pull out. If 10% or fewer anchors are damaged, replace the damaged anchors in the existing asphalt. Anchor bolts used on systems mounted on asphalt must be inspected every 6 months. See Post Impact Instructions and Maintenance and Repair instructions in the QuadGuard II Assembly Manual for details.

The QuadGuard® II system may be installed on any of the following foundations using the specified anchorage:

Foundation A: Concrete Pad or Roadway

Foundation: 150 mm [6"] minimum depth Portland Cement Concrete (P.C.C.)
Anchorage: MP-3® with 180 mm [7"] studs 140 mm [5 1/2"] embedment

Foundation B: Asphalt over P.C.C.

Foundation: 76 mm [3"] minimum asphalt concrete (A.C.) over 76 mm [3"] minimum P.C.C.
Anchorage: Length of anchor required is 180 mm [18"] 420 mm [16 1/2"] embedment

Foundation C: Asphalt over Subbase

Foundation: 150 mm [6"] minimum A.C. over 150 mm [6"] minimum Compacted Subbase (C.S.)
Anchorage: MP-3 with 460 mm [18"] studs 420 mm [16 1/2"] embedment

Foundation D: Asphalt Only

Foundation: 200 mm [8"] minimum A.C.
Anchorage: MP-3 with 460 mm [18"] studs - 420 mm [16 1/2"] embedment

Foundation Specifications

for Foundations A, B, C and D mentioned above:
A. C. (Asphalt Concrete)
AR-4000 A. C. (per ASTM D3381 '83) 3/4” Maximum, Medium (Type A or B) aggregate

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Operating Range (% Passing)</th>
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<tbody>
<tr>
<td>1”</td>
<td>100</td>
</tr>
<tr>
<td>3/4”</td>
<td>95-100</td>
</tr>
<tr>
<td>3/8”</td>
<td>65-80</td>
</tr>
<tr>
<td>No. 4</td>
<td>49-54</td>
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<tr>
<td>No. 8 3</td>
<td>6-40</td>
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<tr>
<td>No. 30 1</td>
<td>8-21</td>
</tr>
<tr>
<td>No. 200</td>
<td>3-8</td>
</tr>
</tbody>
</table>

Caution: Walk-up inspections are recommended at least once every six months for installations on asphalt.

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

<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>
</tr>
<tr>
<td>2 1/2&quot;</td>
<td>90-100</td>
</tr>
<tr>
<td>No. 4</td>
<td>40-90</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-25</td>
</tr>
</tbody>
</table>
Assembly

The QuadGuard® II system is potentially reusable. 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. That decision is for the appropriate highway authority specifying the maintenance to be performed.

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 three hours depending on the damage done to the system.

Recommended Tools

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

**Cutting equipment**
- Rebar cutting bit
- Concrete drill bits – 22 mm [7/8"] (*Two Fluted)
- Grinder, Hacksaw or Torch (optional)
- Electric or Air Drill
- Drill bits 1/16” through 7/8”

* Energy Absorption Systems recommends using two fluted drills bits to achieve acceptable tensile strength when applying the MP-3® anchoring system.

**Hammers**
- Rotohammer
- 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"
- 1/2” drive Deep sockets: 15/16", 1 1/4"
- Ratchet and attachments for the above sockets
- 1/2” drive Ratchet and attachments
- 1/2” drive Breaker bar - 24” long
- 1/2” drive Torque wrench: 200 ft.-lb.
- Crescent Wrench: 300 mm [12”]
- Allen Wrench: 3/8
- Impact Wrench: 1/2"
Personal Protective equipment

- Safety Glasses
- Gloves
- Apron for MP-3® application

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. Depending on specific site conditions and the complexity of the assembly specified by the appropriate highway authority, additional or fewer tools may be required. Decisions as to what tools are required to perform the job are entirely within the discretion of the specifying highway authority and the authority’s selected contractor performing the assembly of the system at the authority’s specified site.
Life Expectancy

Environment

Except due to impact damage, it is anticipated that the Cartridges can survive in a highway environment for a period ranging from 10 to 15 years from the date of assembly.

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.

Caution: After an impact, always follow the “Post-Impact Instructions” in the maintenance and repair section of the Assembly Manual.
QuadGuard® II System w/Tension Strut Backup Wide
QuadGuard® II System w/Concrete Backup Wide

1. In compliance with the AASHTO 2003 Roadside Design Guide, the 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 752 (30.00) mm.

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'-0") WIDE BY 15.24 m (50'-0") LONG.

4. See the "QuadGuard® II 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) 323-6374.

5. Where necessary, the customer shall supply an adequate transition from the QuadGuard® II System to the object being shielded.

6. Units of measurement are meters [inches] unless otherwise noted.

7. Backup, monorail, and noise assemblies are not included in model number. Order separately.

8. The QuadGuard II Family has been fully tested to NCHRP 350.
QuadGuard® II System Construction Zone System

ATTACH SYSTEM USING ONE OF THE FOLLOWING:
- 7' STUDS MAY BE USED TO ATTACH SYSTEM TO 28 MPA (4000 PSI) MIN. P.C. CONCRETE PER THE FOLLOWING MINIMUMS:
  a) 150 [18] NON-REINFORCED ROADWAY OF PAD
  b) 200 [30] REINFORCED PORTABLE PAD PER THE REFERENCE DETAIL 
  c) 190 [23] DECK STRUCTURE
- 18' THREADED RODS MAY BE USED TO INSTALL SYSTEM ON ASPHALT

**REFER TO THE QUADGUARD II CZ MP-3 ANCHORING SYSTEM INSTALLATION INSTRUCTIONS FOR SPECIFICATIONS**

4. SEE THE "QUADGUARD II 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) 323-6374

5. WHERE NECESSARY, THE CUSTOMER SHALL SUPPLY AN ADEQUATE TRANSITION FROM THE QUADGUARD II SYSTEM TO THE OBJECT BEING SHIELDED.

6. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.

7. BACKUP, MONORAIL, ANCHOR, AND NOSE ASSEMBLIES ARE NOT INCLUDED IN MODEL NUMBER ORDER SEPARATELY.

8. THE QUADGUARD II HAS BEEN FULLY TESTED TO NCHRP 350.
QuadGuard® II System 8" Concrete Pad for Tension Strut Backup

### TABLE

<table>
<thead>
<tr>
<th>NO. OF BAYS</th>
<th>YARDS OF CONCRETE IN PAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L (PAD LENGTH)</td>
</tr>
<tr>
<td>1</td>
<td>5.74 (9'-0&quot;)</td>
</tr>
<tr>
<td>2</td>
<td>5.74 (9'-0&quot;)</td>
</tr>
<tr>
<td>3</td>
<td>6.66 (12'-0&quot;)</td>
</tr>
<tr>
<td>4</td>
<td>5.57 (15'-0&quot;)</td>
</tr>
<tr>
<td>5</td>
<td>5.49 (18'-0&quot;)</td>
</tr>
<tr>
<td>6</td>
<td>5.40 (21'-0&quot;)</td>
</tr>
<tr>
<td>7</td>
<td>5.38 (24'-0&quot;)</td>
</tr>
<tr>
<td>8</td>
<td>5.29 (27'-0&quot;)</td>
</tr>
<tr>
<td>9</td>
<td>5.14 (30'-0&quot;)</td>
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</tbody>
</table>

**NOTES:**

1. CROSS SLOPE OF PAD SHALL NOT EXCEED 8%, AND NOT VARY MORE THAN 2% FROM FRONT TO BACK.
2. UNITS OF MEASUREMENT ARE MILLIMETERS (INCHES) UNLESS OTHERWISE NOTED.

**REFERENCES:**

- W. Liddington 5/27/09
- S. Trojeser 5/28/09
- M. J. Bueller 5/28/09

**QUADGUARD II SYSTEM CONCRETE PAD FOR TENSION STRUT BACKUP**
QuadGuard® II System Backup Assembly, TS, QG
QuadGuard® II System Concrete Backup, QG on Grade
QuadGuard® II System Concrete B-up, QG on Existing Concrete Structure
QuadGuard® II System Concrete Pad, for Concrete Backup, QG
QuadGuard® II Backup Assembly, Concrete, QG

22 [0.875] HOLE X 115 [4.50] DEEP (4 PLACES) SEE NOTE 3

22 [0.875] HOLE X 140 [5.50] MIN. DEEP, 8 PLACES
### TABLE

<table>
<thead>
<tr>
<th>NO. OF BAYS</th>
<th>&quot;w&quot;</th>
<th>&quot;p&quot;</th>
<th>REBAR REQUIRED</th>
<th>YARDS OF CONCRETE (IN PAD)</th>
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<tbody>
<tr>
<td></td>
<td>(ft-in)</td>
<td>(ft-in)</td>
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<td>(in)</td>
</tr>
<tr>
<td>2</td>
<td>4.57</td>
<td>1.1</td>
<td>2.50 (63&quot;-6&quot;)</td>
<td>1.2</td>
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<td>3</td>
<td>4.57</td>
<td>1.1</td>
<td>2.50 (63&quot;-6&quot;)</td>
<td>1.2</td>
</tr>
<tr>
<td>4</td>
<td>4.57</td>
<td>1.1</td>
<td>2.50 (63&quot;-6&quot;)</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>5.49</td>
<td>1.4</td>
<td>31.39 (103&quot;-6&quot;)</td>
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</tr>
<tr>
<td>6</td>
<td>6.40</td>
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<td>36.17 (118&quot;-6&quot;)</td>
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<tr>
<td>7</td>
<td>7.38</td>
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<td>49.06 (138&quot;-6&quot;)</td>
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<td>8</td>
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<td>2.0</td>
<td>68.84 (156&quot;-6&quot;)</td>
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<td>9</td>
<td>9.14</td>
<td>2.2</td>
<td>75.73 (173&quot;-6&quot;)</td>
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NOTE: ADD (1) 13mm [#8] REBAR # "p" AS NEEDED.

SECTION A-A

"L" (SEE TABLE)

OPTIONAL LIFTING POINTS - (4 LOCATIONS) (SEE SECTION A-A)

SECTION B-B

"p"

100 [4"]

100 [4"]

50 [2"]

355 [1-2"] (TYP)

GRADE

200 [8"]

30 MPa [4000 PSI] STONE AGGREGATE CONCRETE 2320 kg/m³ [145 lbs/ft³]

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

REFERENCES

<table>
<thead>
<tr>
<th>REFERENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. Stauss 5/15/96</td>
</tr>
<tr>
<td>W.G. 3/1996</td>
</tr>
<tr>
<td>S. Trageser 5/24/96</td>
</tr>
<tr>
<td>W.G. 5/28/96</td>
</tr>
</tbody>
</table>

QuadGuard® II System Concrete Pad, cz, QG
QuadGuard® II System cz Anchor/Lifting Kit, QG, (3-9 Bays)
QuadGuard® II System cz Anchor/Lifting Kit, QG, (3-9 Bays)
QuadGuard® II System Monorail Assembly, QG
QuadGuard® II System Monorail Assembly, QG
Diaphragm Assembly, QG

PARTS LIST

<table>
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<tr>
<th>ITEM</th>
<th>STOCK NO.</th>
<th>DESCRIPTION</th>
<th>QTY</th>
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<tbody>
<tr>
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<td>6078210</td>
<td>DIAPHRAGM QS, QG, Q</td>
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<td>6</td>
<td>5113895</td>
<td>MONORAIL GUIDE, QQ G</td>
<td>2</td>
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<td>9</td>
<td>1155465</td>
<td>Bolt 1/4&quot; GB SH</td>
<td>4</td>
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<td>10</td>
<td>1155655</td>
<td>BOLT 1/4&quot; GB SH</td>
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<td>11</td>
<td>1156085</td>
<td>WASHER LOCK 3/4&quot; G</td>
<td>4</td>
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<td>12</td>
<td>5054460</td>
<td>BRACKET CARTRIDGE, SUPT; QA; FOLDED; QQ G</td>
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</tbody>
</table>

PART NO. SEE TABLE

Revisions: Date  Rev  Br  Sht  Apps
607113  6/4/09  B  12  SC
607113  1/11/11  H  12  SC

NOTE:
1. QUADGUARD II AND QGM TO REQUIRE THE SHIM KIT, SEE 614000.

SEE NOTE 1
Shim Kit, Diaphragm, Rail guide, QG II
Fender Panel Assembly, QG
QuadGuard® II System Backup Assembly, TS, QG Wide
Backup Assembly, Concrete, QG Wide

### TABLE

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<th>ASSY. NO.</th>
<th>ITEM 1</th>
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<tr>
<td>604513B</td>
<td>6046328</td>
<td>BACKUP FACE:CONC,64.0G, WIDE,G</td>
<td>1620</td>
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<td>604513B</td>
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<td>BACKUP FACE:CONC,100.0G, WIDE,G</td>
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### PARTS LIST

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<td>BACKUP FACE:CONC,_____ G, WIDE,G</td>
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<td>2</td>
<td>603670B</td>
<td>ANCHOR MP-3/12,1/4X1/2 HMR</td>
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<tr>
<td>3</td>
<td>601729B</td>
<td>HINGE PLATE, FENDER PANEL, 12G</td>
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<td>5</td>
<td>601900B</td>
<td>PANEL SIDE, GOG, WIDE,G</td>
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<td>6</td>
<td>111560G</td>
<td>NUT, 3/8, R/LG</td>
<td>1.00</td>
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<tr>
<td>10</td>
<td>1156660G</td>
<td>BOLT, 5/8X4.0/5, G</td>
<td>6.00</td>
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<tr>
<td>11</td>
<td>118000G</td>
<td>WASHER LOCK, 5/8, G</td>
<td>6.00</td>
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<tr>
<td>12</td>
<td>603673B</td>
<td>ANCHOR MP-3/12, 1/4X3/4 X7 VT</td>
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<tr>
<td>13</td>
<td>615709G</td>
<td>MONORAIL ONE BAY, 90, G</td>
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<td>14</td>
<td>115970G</td>
<td>NUT, 3/8, R/LG</td>
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<td>003360C</td>
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<td>NUT, 3/8, R/LG</td>
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<td>17</td>
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<td>TEL ST 1/3/12, 3/4X12, H/S, G, 10, LG</td>
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<td>19</td>
<td>1156650G</td>
<td>BOLT, 5/8X3, 1/2X2, R/LG, ALL THREAD</td>
<td>16.0</td>
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NOTES:
1. Dimensions are in millimeters [inches] unless otherwise noted.
2. For reference only. Use item 1 as a template to drill holes in concrete.
3. Item 13 to be centered laterally with backup c.
4. A rebar cutting bit will likely be required to achieve proper anchor installation.

### REFERENCES

- Energy Absorption Systems, Inc.
- Engineering and Research Department
- Concrete Backup, QG Wide 35-40-41
- G. Staws
- J. Muchado
- B. Mawr
- S. Trageser

### REVISIONS

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Rev</th>
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<tr>
<td>ITEM 10 WAS 269957-0000</td>
<td>7/8/97</td>
<td>D</td>
</tr>
<tr>
<td>ADDED 120° BACKUP TO TABLE</td>
<td>1/19/97</td>
<td>E</td>
</tr>
<tr>
<td>NOS. SHOWN=SIDE &amp; BOXED HORIZONTALS</td>
<td>7/8/97</td>
<td>E</td>
</tr>
</tbody>
</table>

**Backup Assy, Concrete, QG Wide**
QuadGuard® System (69") Concrete Pad & Backup, QG Wide on Grade
QuadGuard® Wide System Fender Panel Assembly

NOTES:
1. UNDERLYING PANEL IS A FENDER PANEL IF ATTACHED TO A DIAPHRAGM.
2. UNDERLYING PANEL IS A BACKUP PANEL OR TRANSITION PANEL IF ATTACHED TO THE BACKUP.
3. UNITS OF MEASUREMENT ARE MILLIMETERS (INCHES) UNLESS OTHERWISE NOTED.
4. TIGHTEN NUT UNTIL IT REACHES END OF THREADS.

CAUTION
2.5 (1) MAX. GAP FOR PROPER IMPACT PERFORMANCE.

Parts List

<table>
<thead>
<tr>
<th>Item</th>
<th>Stock No.</th>
<th>Description</th>
<th>QTY</th>
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<tbody>
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<td>517165G</td>
<td>WASHER MUSSLE FORGED 0.0G</td>
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<td>3</td>
<td>116785G</td>
<td>SCREW 1/4&quot; 2.25-11X1.5 ALY</td>
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<td>4</td>
<td>114459G</td>
<td>SPRING 1/4&quot; X 2 DD.304 ALY</td>
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<td>5</td>
<td>003840C</td>
<td>NUT 3/8&quot; G RAIL</td>
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</tr>
<tr>
<td>6</td>
<td>003400G</td>
<td>BOLT RAIL 5/16&quot;</td>
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</tbody>
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TWO FENDER PANEL ASSEMBLIES REQUIRED PER BAY.
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 REVEISED AND DETERMINATIONS MADE AS TO REASONABLE EQUIVALENCE BY PROJECT ENGINEER.

2. USE ANCHOR PLATE AS TEMPLATE FOR DRILLING.

3. RECOMMENDED HOLE DEPTH INTO POMB IS 12[5.50] DRILL 4 HOLES IF NECESSARY TO INSTALL A MINIMUM OF 2 ANCHOR BOLTS PER BRACKET. FINAL TORQUE TO BE 163 kN(120 M=IN) (Typ).

4. IMPACT FORCES CAN BE TRANSFERRED INTO TERMINAL END OF THE BARRIER, ADEQUATE ANCHORAGE IS REQUIRED TO ENSURE PROPER IMPACT PERFORMANCE. POMB MUST BE ANCHORED TO A ROCK SURFACE (NOT DIRT) WITH A MINIMUM OF 12 THREADED RODS (ITEM 3) AS SHOWN. ANCHOR BOTH SIDES OF BARRIER USING ITEM 1 (6 REQUIRED) ATTACH POMB USING ONE OF THE FOLLOWING:

5. 1/2" STEEL MAY BE USED TO ANCHOR POMB TO 28 MPA (4000 PSI) MIN. P.C. CONCRETE PER THE FOLLOWING MINIMUM CONCRETE DEPTHS:**
   a) 150 [6.00] NON-REINFORCED ROADWAY.
   b) 180 [7.00] DECK STRUCTURE.
   c) 1/2" THREADED RODS MAY BE USED TO ANCHOR POMB TO 6" MIN. THICKNESS.
   d) MIN. 28 MPA (4000 PSI) P.C. CONCRETE MEDIAN BARRIER.

6. DIMENSIONS ARE IN MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.

**REFER TO THE QUADGUARD GZ MP-3 ANCHORING SYSTEM INSTALLATION INSTRUCTIONS FOR SPECIFICATIONS.

QuadGuard® System PCMB Anchor Assembly
QuadGuard® 4” Offset Transition Assembly
Notes