QuadGuard® M10 TL-3 System
Crash Cushion

Product Description
Instructional Manual

TRINITY
HIGHWAY PRODUCTS
ENERGY ABSORPTION SYSTEMS
2525 North Stemmons Freeway
Dallas, TX 75207

IMPORTANT: These instructions are to be used only in conjunction with the assembly, maintenance, and repair of the QuadGuard® M10 TL-3 System. These instructions are for standard assemblies specified by the appropriate highway authority only. In the event the specified system assembly, maintenance, or repair requires or involves deviations from standard parameters, contact the appropriate highway authority engineer. Energy Absorption Systems representatives are available for consultation if required.

This Manual must be available to the worker at all times. For additional copies, contact Energy Absorption Systems at (888) 323-6374 (outside the USA call (312) 467-6750).

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® M10 TL-3 System information available to Energy Absorption Systems at the time of printing. We reserve the right to make changes at any time.

Part no. 617684B

www.highwayguardrail.com
www.energyabsorption.com

Revised November, 2011
All rights in copyright preserved
Table of Contents

Customer Service Contacts ....................................................................................................... 4
Important Introductory Notes ..................................................................................................... 4
System Overview ....................................................................................................................... 5
Crash Performance .................................................................................................................... 5
Recommended Safety Rules for Assembly ............................................................................... 6
Warnings and Cautions .............................................................................................................. 7
Limitations and Warnings .......................................................................................................... 8
How to Determine Left/Right ................................................................................................... 10
Counting the Number of Bays .................................................................................................. 10
Measuring the Width ................................................................................................................ 11
Assembly Tools, Equipment, and Materials ............................................................................. 12
  Documentation ..................................................................................................................... 12
  Machines ............................................................................................................................ 12
  Cutting Equipment ............................................................................................................. 12
  Tools .................................................................................................................................. 12
  Other Materials ................................................................................................................ 12
  Safety Equipment ............................................................................................................. 12
QuadGuard® M10 TL-3 Systems for Narrow Hazards ............................................................. 13
System Assembly for Narrow Hazards .................................................................................... 13
  Site Preparation/Foundation ............................................................................................... 13
  System Assembly Procedures .......................................................................................... 14
QuadGuard® M10 TL-3 Systems for Wide Hazards ................................................................. 29
System Assembly for Wide Hazards ....................................................................................... 29
  Site Preparation/Foundation ............................................................................................... 29
  System Assembly Procedures .......................................................................................... 30
MP-3® Polyester Anchoring System ......................................................................................... 44
  Vertical Assemblies .......................................................................................................... 45
  Horizontal Assemblies ...................................................................................................... 47
Maintenance and Repair .......................................................................................................... 49
  Inspection Frequency ......................................................................................................... 49
  Visual Drive-By Inspection ............................................................................................... 49
  Walk-Up Inspection .......................................................................................................... 50
Post-Impact Instructions for Narrow Hazards ......................................................................... 50
Post-Impact Instructions for Wide Hazards ............................................................................ 53
Parts Ordering Procedure ......................................................................................................... 55
www.highwayguardrail.com
www.energyabsorption.com

Revised November, 2011
All rights in copyright preserved
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix</td>
<td>58</td>
</tr>
<tr>
<td>Narrow System - Concrete Backup</td>
<td>58</td>
</tr>
<tr>
<td>Narrow System – Tension Strut Backup</td>
<td>59</td>
</tr>
<tr>
<td>Wide System – Concrete Backup</td>
<td>60</td>
</tr>
<tr>
<td>Wide System – Tension Strut Backup</td>
<td>61</td>
</tr>
<tr>
<td>Narrow System – Diaphragm Assembly</td>
<td>62</td>
</tr>
<tr>
<td>Diaphragm Shim Kit</td>
<td>63</td>
</tr>
<tr>
<td>Nose Assembly - Narrow System</td>
<td>64</td>
</tr>
<tr>
<td>Fender Panel Assembly - Narrow System</td>
<td>65</td>
</tr>
<tr>
<td>Concrete Backup on Grade - Narrow System</td>
<td>66</td>
</tr>
<tr>
<td>Concrete Backup on Existing Concrete - Narrow System</td>
<td>67</td>
</tr>
<tr>
<td>Concrete Backup Assembly - Narrow System</td>
<td>68</td>
</tr>
<tr>
<td>Concrete Pad For Concrete Backup - Narrow System</td>
<td>69</td>
</tr>
<tr>
<td>Tension Strut Backup Assembly - Narrow System</td>
<td>70</td>
</tr>
<tr>
<td>Diaphragm Assembly - Wide System, SH. 1</td>
<td>71</td>
</tr>
<tr>
<td>Diaphragm Assembly - Wide System, SH. 2</td>
<td>72</td>
</tr>
<tr>
<td>Nose Assembly - Wide System</td>
<td>73</td>
</tr>
<tr>
<td>Fender Panel Assembly - Wide System</td>
<td>74</td>
</tr>
<tr>
<td>Concrete Backup Assembly - Wide System</td>
<td>75</td>
</tr>
<tr>
<td>Concrete Pad and Backup - Wide System, SH. 1</td>
<td>76</td>
</tr>
<tr>
<td>Concrete Pad and Backup - Wide System, SH. 2</td>
<td>77</td>
</tr>
<tr>
<td>Concrete Pad and Backup - Wide System, SH 3</td>
<td>78</td>
</tr>
<tr>
<td>Tension Strut Backup Assembly - Wide System</td>
<td>79</td>
</tr>
<tr>
<td>Concrete Pad for Tension Strut Backup</td>
<td>80</td>
</tr>
<tr>
<td>Optional 8&quot; Concrete Pad for Tension Strut Backup</td>
<td>81</td>
</tr>
<tr>
<td>Monorail Assembly, SH. 1</td>
<td>82</td>
</tr>
<tr>
<td>Monorail Assembly, SH. 2</td>
<td>83</td>
</tr>
<tr>
<td>Monorail Assembly, SH. 3</td>
<td>84</td>
</tr>
</tbody>
</table>
Customer Service Contacts

Energy Absorption Systems (a Trinity Industries, Inc. company) is committed to the highest level of customer service. Feedback regarding the QuadGuard® M10 TL-3 System, its assembly procedures, supporting documentation, and performance is always welcome. Additional information can be obtained from the contact information below:

<table>
<thead>
<tr>
<th>Energy Absorption Systems:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Telephone:</td>
<td>(888) 323-6374 (USA Only)</td>
</tr>
<tr>
<td></td>
<td>(312) 467-6750 (USA or International)</td>
</tr>
<tr>
<td>E-mail</td>
<td><a href="mailto:customerservice@energyabsorption.com">customerservice@energyabsorption.com</a></td>
</tr>
<tr>
<td></td>
<td><a href="http://www.highwayguardrail.com/">http://www.highwayguardrail.com/</a></td>
</tr>
<tr>
<td></td>
<td><a href="http://www.trin.net/">http://www.trin.net/</a></td>
</tr>
<tr>
<td>Trinity Highway Products, LLC.</td>
<td></td>
</tr>
<tr>
<td>Trinity Industries, Inc.</td>
<td></td>
</tr>
</tbody>
</table>

Important Introductory Notes

Proper assembly of the QuadGuard® M10 TL-3 System is essential to assure maximum performance. These instructions should be read in their entirety and understood before assembling the QuadGuard® M10. These instructions are to be used only in conjunction with the assembly of the QuadGuard® M10 TL-3 System and are for standard assemblies only as specified by the applicable highway authority. In the event your system assembly requires or involves deviations from standard parameters or, during the assembly process, a question arises regarding a particular assembly step, please contact the appropriate highway authority that specified this QuadGuard M10 System at this particular location for guidance. Energy Absorption Systems is available for consultation with that agency.

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 supersede these instructions and should be reviewed and studied thoroughly by a qualified individual before the start of any assembly.
System Overview
The QuadGuard® M10 TL-3 System is a highly efficient, non-gating crash cushion for hazards ranging in width from 610 mm to 2286 mm (2' to 7.5') which has the potential to be redirective if impacted within applicable FHWA criteria. It consists of crushable, energy-absorbing cartridges surrounded by a framework of Quad-Beam™ panels.

Crash testing, using FHWA criteria, reveals that during head-on impacts, the QuadGuard® M10 TL-3 System telescopes rearward and crushes cartridges to absorb the energy of impact. The same testing shows that, when impacted from the side, the system redirects the vehicle back toward its original travel path and away from the hazard.

The QuadGuard® M10 TL-3 System utilizes two types of cartridges in a "staged" configuration to address both lighter cars and heavier, high center-of-gravity vehicles.

Crash Performance
The 6-bay QuadGuard® M10 TL-3 System has been tested and evaluated according to the recommendations of the MASH Guidelines for Test Level 3 (TL-3) Terminals and Crash Cushions and has been accepted for use on the national highway system. The impact conditions recommended in this guideline are intended to encompass the majority, but not all, of the possible in-service impacts.

Copies of the MASH Guidelines for Test Level 3 (TL-3) may be obtained from:

Transportation Research Board
National Research Council
2101 Constitution Avenue, NW.
Washington, D.C. 20418

When properly assembled, and maintained, the QuadGuard® M10 TL-3 System has demonstrated, in MASH crash testing criteria, that it is capable of performing its function of stopping or containing and redirecting the test vehicles in a predictable and under the nominal MASH TL-3 terminal and crash cushion impact conditions of:

Vehicles:  Small car and pickup
Mass:     1100 and 2270 kg [2420 and 5000 lb.]
Speed:    100 km/h [62 mph]
Angle:    15 degrees for small vehicle and 25 degrees for pickup

Impact conditions which differ from those described in the MASH test matrix for non-gating, redirecting crash cushions, have not been tested and it is likely that such impacts 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 assembly) of curbs or cross slopes in excess of 8% may yield crash performance which does not meet MASH evaluation criteria relative to structural adequacy, occupant risk and vehicle trajectory factors.
**Important:** Read the safety instructions thoroughly and follow the suggested safe practices before assembling, maintaining, or repairing the QuadGuard® M10. Failure to follow this warning can result in serious injury or death to the worker and/or bystanders. Please keep these instructions for later use.

**Warning:** Ensure that all of the QuadGuard® M10 Warnings, Cautions, and Important statements within the QuadGuard® M10 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 System 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® M10 TL-3 System. Additional copies of this Manual are available from Energy Absorption Systems by calling (888) 323-6374 (outside the USA call (312) 467-6750). Please contact Energy Absorption Systems if you have any questions concerning the information in this Manual or about the QuadGuard® M10 TL-3 System.

Always use appropriate safety precautions when operating power equipment, mixing chemicals, and when moving heavy equipment or the QuadGuard® M10 components. Work gloves, safety goggles, steel toe boots and back protection should be used.

Safety measures incorporating traffic control devices must be used to provide safety for personnel while at the assembly, maintenance, or repair site.

### Safety Symbols

This section describes safety symbols that may appear in the QuadGuard® M10 TL-3 System 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>![#]</td>
<td>Safety Alert Symbol</td>
</tr>
<tr>
<td>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>
<td></td>
</tr>
</tbody>
</table>
**Warnings and Cautions**

Read all instructions before assembling, maintaining, or repairing the QuadGuard® M10 TL-3 System.

**Warning:** Do not assemble, maintain, or repair the QuadGuard® M10 TL-3 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 (outside the USA call (312) 467-6750) 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 traffic control devices 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:** Be sure adequate time is available for complete assembly, maintenance, or repair before beginning the assembly, maintenance, or repair process. 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 for assembling, maintaining, or repairing a QuadGuard® M10 TL-3 System. System assembly, maintenance, or repairs using unauthorized accessories or even other Energy Absorption or Trinity parts is strictly prohibited. Failure to follow this warning will compromise the acceptance of this system by the FHWA and could result in serious injury or death in the event of a vehicle impact with a NONAPPROVED system.

**Warning:** Do NOT modify the QuadGuard® M10 TL-3 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® M10 TL-3 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.

**Warning:** Ensure that there is proper site grading for the QuadGuard® M10 TL-3 System placement as dictated by the state or specifying agency, pursuant to Federal Highway Administration (FHWA) acceptance. Failure to follow this warning could result in serious injury or death in the event of a collision.
Limitations and Warnings

The 6 bay QuadGuard® M10 TL-3 System has been tested and evaluated per the recommendations of the MASH Guidelines* for Test Level 3 (TL-3) terminals and crash cushions. The impact conditions recommended in this guideline are intended to encompass the majority but not all, of the possible in-service collisions. Properly assembled and maintained, the QuadGuard® M10 TL-3 System is capable of performing its function of stopping or containing and redirecting the test vehicles in a predictable manner under the nominal MASH TL-3 terminal and crash cushion impact conditions of:

- **Vehicles:** Small car and pickup
- **Mass:** 1100 and 2270 kg [2420 and 5000 lb.]
- **Speed:** 100 km/h [62 mph]
- **Angle:** 15 degrees for small vehicle and 25 degrees for pickup

Impact conditions which differ from those described in the MASH 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 assembly) of curbs or cross slopes in excess of 8% may yield crash performance which does not meet MASH evaluation criteria relative to structural adequacy, occupant risk, and vehicle trajectory factors.

* A copy of the MASH Guidelines may be obtained from:

Transportation Research Board  
National Research Council  
2101 Constitution Avenue, N.W.  
Washington, D.C. 20418
Know Your QuadGuard® M10 TL-3 System

For a specific assembly, maintenance, or repair details, refer to the state or specifying agency's standard drawing(s) and/or Energy Absorption Systems standard layout drawings.

Figure 1
Plans and Elevation (Six bay Systems with Tension Strut Backups shown)

Key

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

www.highwayguardrail.com
www.energyabsorption.com

Revised November, 2011
All rights in copyright preserved
**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 2. Your left is the System's left and your right is the System's right.

![Diagram of System Orientation](image)

**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, although there is a Cartridge in the Nose of each System.

Note: There will always be one more Cartridge in the System than the number of bays. To determine the number of bays, count the Fender Panels on one side, see Figure 2 (A 6-bay System is shown).
Measuring the Width

The QuadGuard® M10 TL-3 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 a **Tension Strut Backup** is the width between Side Panels behind the Backup (see Figure 3).

The nominal width of a System with a **Concrete Backup** is the width of the Concrete Backup at the location shown in Figure 4.

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 3**
*Width of System with a Tension Strut Backup*

**Figure 4**
*Width of System with a Concrete Backup*
Assembly Tools, Equipment, and Materials

Documentation
- Manufacturer's Instructional Manual
- Manufacturer's Drawing Package
- Packing Slip (see Note 1)

Machines
- Lifting and Moving Equipment. Minimum 5,000 lb. capacity required. (A lifting device is preferred, e.g. a forklift or boom truck)
- Compressor (100 psi)
- Generator (5 KW)

Cutting Equipment
- Rebar Cutting Bit
- 22 mm [7/8"] Concrete Drill Bits (Two Fluted) Energy Absorption Systems recommends using two-fluted drills to achieve optimum tensile strength when assembling the MP-3® anchoring system.
- Grinder, Hacksaw or Torch (optional)
- Drill Motor
- Drill Bits: 1/16" through 7/8"

Tools (See Note 2)
- Sledgehammer
- Hammer
- Long Pry Bar
- Drift Pin 300 mm [12”]
- Center Punch
- Rotary Hammer Drill
- 1/2” Drive Impact Wrench
- 12” Adjustable Wrench
- 1/4” or 3/8” Ratchet with a 7/16” Socket
- Open End Wrench: 7/16” and 9/16”
- 1/2” Drive Sockets: 7/16”, 9/16”, 1 1/16”, 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: 1/2” X 200 ft-lbs
- Allen Wrench: 3/8”
- Air Hose
- Extension Cord
- 100 mm (4”) C-Clamp

Other Materials
- Tape Measure 7.5 m [24’]
- Chalk Line
- Concrete Marking Pencil
- Nylon Bottle Brush for cleaning 22 mm [7/8”] drilled holes
- Rags, Water, and Solvent for Touch-up
- Steel Toe Boots
- Back Protector

Safety Equipment
- Traffic Control Equipment
- Safety Glasses
- Work Gloves

Notes:
1. Review the packing slip and make sure all the parts have been shipped.
2. 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 assembly specified by the appropriate highway authority; more or less tools may be required. The decision as to what tools are needed 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 installation site.
QuadGuard® M10 TL-3 Systems for Narrow Hazards

System Assembly for Narrow Hazards

Site Preparation/Foundation
A QuadGuard M10 TL-3 System should be assembled only on an existing or freshly placed and cured concrete base (28 MPa [4000 psi] minimum). Location and orientation of the concrete base and attenuator must comply with project plans or as otherwise determined by the resident project engineer.

Recommended dimension and reinforcement specifications for new concrete pads are provided in the Energy Absorption Systems Concrete Pad Drawings supplied with the System. The System may be assembled on reinforced concrete roadway (minimum 150 mm [6"] thick X 1.22 m [40"] wide X 6.4 m [21"] long). The cross slope shall not exceed 8% at the location of the system (see Figure 6) and should not vary (twist) more than 2% over the length of the System; the pad surface shall have a light broom finish.

Caution: Accurate placement of all steel rebar is critical to avoid interference with the concrete anchor bolts.
**Warning:** Location of the Backup in relation to nearby objects will affect the operation of the attenuator. Upon impact, the Fender Panels telescope toward and extend beyond the rigid Backup as much as 760 mm [30"] from their pre-impact location. Position the Backup so that the rear ends of the last Fender Panels are a minimum of 760 mm [30"] forward of objects that would otherwise interfere with movement of the Panels. Failure to comply with this requirement may result in impaired System performance offering motorists less protection and cause component damage.

**System Assembly Procedures**

**Note:** The drawing package supplied with the QuadGuard® M10 TL-3 System must be used with these instructions for proper assembly and should take precedence over these general instructions.

<table>
<thead>
<tr>
<th>Step</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Determine Backup and Transition Type</strong></td>
</tr>
</tbody>
</table>

The System is available with a Tension Strut Backup or a Concrete Backup. See Figures 7 and 8, along with the Backup Assembly Drawings to determine which type of Backup is being assembled.

- **Figure 7**
  - Tension Strut Backup
  - *610 mm [24"]
  - *760 mm [30"]
  - *915 mm [36"]

- **Figure 8**
  - Concrete Backup
  - *610 mm [24"]
  - *760 mm [30"]
  - *915 mm [36"]
A Transition Panel or Side Panel will be used on each side of the Backup. A Side Panel is not needed when a Transition Panel is used. Several types of Transitions are available for use with the QuadGuard® M10 TL-3 System. See Figures 9 through 13 and the drawing package to determine which type of panel is being assembled.

**QUAD-BEAM™ END SHOE TRANSITION PANEL**

*Note: Wheel Deflectors may be required for bidirectional applications.*

**Figure 9**
Transitioning the QuadGuard® M10 TL-3 System

**Figure 10**
No Transition

**Figure 11**
Quad-Beam™ to Safety Shape Barrier Transition Panel

**Figure 12**
Quad-Beam™ to Thrie-Beam Transition Panel

**Figure 13**
Quad-Beam™ to W-Beam Transition Panel
**Transition Panel Types:** The proper Transition or Side Panel must be used for accepted impact performance of the System. The correct Panel to use will depend on the direction of traffic and what type of barrier or hazard the QuadGuard M10® System is shielding. Contact the Customer Service Department prior to system assembly if you have any questions.

**WARNING:** Only Strong Soil, AASHTO M147 with static performance >90% is to be used with the assembly of a transition in soil.

**WARNING:** Only steel posts with wood blocks are to be used for the Quad-Beam™ to W-Beam or Quad-Beam™ to Thrie-Beam Transition.

### 2. Mark the System Location

1. Locate the centerline of the System by measuring the proper offset from the hazard. See the drawing package supplied with the System.
2. Mark the centerline of the System with a chalk line.
3. Mark a construction line parallel to the center line and offset it 165 mm [6.5"] to one side as shown in Figure 14.
4. The edge of the Monorail will be placed on this line.

**Note:** The Concrete Pad and Concrete Backup (if necessary) should be assembled per the project plans supplied with the System and this Manual.

**Warning:** Location of the System with respect to the hazard is critical and dependent on the type of Transition Panel used. See the project plans supplied with the System for details.

![Figure 14](Top View of Concrete Pad)

### 3. Anchor the Backup

3a. **Concrete Backup Assembly** (Figure 15)

1. Locate the Front Face Plate using the Concrete Backup Assembly Drawing, page 68.
2. Drill four 22mm [7/8"] X 125mm [5"] anchor holes in the Concrete Backup using the Face Plate as a template.
3. Anchor the Face Plate to the Concrete Backup using the MP-3® Anchoring System (Horizontal Kit) supplied with the QuadGuard® M10 TL-3 System (see "MP-3® Polyester Anchoring System" section, page 44).

**WARNING:** Every hole and slot in Backup and Monorail must have an MP-3® bolt anchoring it.
3b. **Tension Strut Backup Assembly** (Figure 16)
1. Locate the Tension Strut Backup with the attached Monorail on the pad with the side of the attached Monorail on the construction line and rear edge of the Backup Foot 100 mm [4"] forward of the edge of the pad (see Figure 19).
2. Verify that any applicable Transition Panels fit properly before anchoring the Backup.
3. Drill Eighteen 22mm [7/8"] X 140mm [5 ½"] anchor holes in the pad using the Backup as a template.
4. Anchor the Backup to the concrete pad using the MP-3® Vertical Kits provided. (See “MP-3® Polyester Anchoring System” section, page 44).

4. **Assemble the Monorail**

4a. **Monorail Assembly for Concrete Backup** (Figure 17)
1. Locate the Monorail on the pad with the side of the Monorail on the construction line and rear edge of the Monorail Foot 255mm [10"] forward of the front face of the Concrete Backup (see Figure 49 and the Monorail Assembly Drawing page 82 to 84).
2. Orient the Monorail so that the Monorail Tongues face the Backup (see Figure 18).
3. Drill 22mm [7/8"] X 140 mm [5 1/2"] deep anchor holes in the pad using the Monorail as a template (see Figure 17). Do not drill through the pad.
4. Anchor each Monorail section using the MP-3® Vertical Kits provided. See Figure 18 and the MP-3® Polyester Anchoring System Instructions, page 44. It is important to place each segment of Monorail in alignment from the back to the front of the System (+/- 6 mm [1/4"]).
**Warning:** Improper alignment at the Monorail splice joints may prevent proper System collapse during an impact (see Figure 18 Detail A).

4b. **Monorail Assembly for Tension Strut Backup** (Figure 19)

1. Locate the Tension Strut Backup and Monorail on the pad with the side of the Monorail on the construction line and rear edge of the Backup Foot 100 mm [4"] forward of the edge of the pad (see Figure 19).

2. Orient the Monorail so that the Monorail Tongues face the Backup (see Figure 19).

3. Drill 22mm [7/8"] X 140 mm [5 1/2"] deep anchor holes in the pad using the Monorail as a template. Do not drill through the pad (see Figure 19).

4. Anchor each Monorail section using the MP-3® Vertical Kits provided. See Figure 18 and the MP-3® Polyester Anchoring System Instructions included with this Manual, page 44. It is important to place each segment of Monorail in alignment from the back to the front of the System (+/- 6 mm [1/4"]).
5. **Attach Side Panels and/or Transition Panels to the Backup Assembly**

Attach a Transition Panel or Side Panel to the side of the Backup using 5/8” rail bolts and 5/8” rail nuts (large) (two places - top and bottom holes only). See Figure 21 and the Tension Strut Backup Assembly Drawing, page 70.

**Assembly tip:** Use a drift pin to align the center hole of the panel with the center hole of the Backup before attaching the rail bolts.

**Note:** A Side Panel is not needed when a Transition Panel is used.
6. **Attach Monorail Guides**
   Attach the Monorail Guides to the Diaphragm as follows:
   1. Insert the 3/4" x 2" G8 hex bolts through the Monorail Guide and Diaphragm. Orient them as shown in Figure 22.
   2. Diaphragm Shims are sandwiched between the Rail Guide and the Diaphragm.
   3. Secure the Shims with 3/4" lock washers and 3/4" hex nuts (typical four places). Also see the Diaphragm Shim Kit Drawing, page 63.
   4. Repeat this for each Diaphragm.

   ![Figure 22: Monorail Guide Attachment](image)
   ![Figure 23: Diaphragm Orientation](image)

7. **Assemble Diaphragms**
   1. Orient a Diaphragm so that the front face of the Quad-Beam™ shape faces toward the nose of the System as shown in Figure 23.
   2. Slide all Diaphragms on the monorail.
   3. Slide all Diaphragms all the way back to ensure the System is able to collapse properly during impact.
      a. Each diaphragm should slide smoothly without any hang ups.
   4. After Step 3a has been verified, slide each Diaphragm forward to approximately 915 mm [36"] in front of each other as shown in Figure 24.

   ![Figure 24: Diaphragm Spacing](image)
**Detail 25a**
*Mushroom Washer Attachment*

**Detail 25b**
*Mushroom Washer Orientation*

---

**SECTION A-A**

---

**Figure 25**
*Fender Panel Assembly*

---

All rights in copyright preserved.

Revised November, 2011

www.highwayguardrail.com

www.energyabsorption.com
8. **Assemble Fender Panels**

   **Note:** Do not mix the 5/8" rail nuts (large) with the 5/8" hex nuts (small). See Figure 20.

   1. Starting at the Backup, attach the left and right Fender Panels as shown in Figure 25, Details 25a and b, and the Fender Panel Assembly Drawing, page 65.
   2. Place the Fender Panel so that the center of the slot of the rearward Diaphragm is lined up with the approximate center of the slot in the Fender Panel.
   3. Attach the Mushroom Washer Assembly as shown in Figure 25 and Details 25a and b, but do not torque at this time. (This helps to balance the Fender Panel.)
      a. Be sure a Mushroom Washer lays flat against the Fender Panel as shown in Detail 25a.
      b. The standoff on the Mushroom Washer must be seated completely through the slot.
   4. Slide the Fender Panel forward until the holes in the Fender Panel line up with the holes in the forward Diaphragm.
   5. Use a drift pin to align the center hole of the Fender Panel with the center hole of the Diaphragm or Backup.
   6. Attach the front of the Fender Panel to the next Diaphragm using two 5/8" rail bolts and 5/8" hex nuts (small) per side. Use only the top and bottom holes; leave the center hole open until the next Fender Panel is assembled.
   7. Check the Diaphragm spacing to ensure there is 915 mm [36"] between rear faces of consecutive Diaphragms as shown in Figure 26 and Fender Panel Assembly Drawing, page 65.
   8. After the proper spacing has been achieved, tighten the Mushroom Washer Assembly (uses 5/8" hex nuts (small)) until it reaches the end of the threads to hold the Diaphragm and Fender Panel in place during assembly of the rest of the System.
   9. Attach the remaining Fender Panels following the procedures in steps 2 thru 8.

9. **Attach End Cap**

   Using a 5/8" x 3 1/2" G5 hex bolt, 5/8" hex nut (small) and 5/8" lock washer, attach the End Cap to the front of the first Monorail segment as shown in Figure 27 and the Monorail Assembly Drawing, pages 82-84.
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>10. Assemble Nose Assembly</strong></td>
<td></td>
</tr>
<tr>
<td>1. Attach the Nose to the front Diaphragm, as shown in Figure 28 and Details 28a-c, and the Nose Assembly Drawing, page 64, using six hex socket bolts which also hold the front two Fender Panels to the Diaphragm with a flat washer under each bolt.</td>
<td></td>
</tr>
<tr>
<td>2. Place the pullout brackets under the center bolts as shown in Details 28b and c.</td>
<td></td>
</tr>
<tr>
<td><strong>11. Check System Spacing</strong></td>
<td></td>
</tr>
<tr>
<td>After the entire System has been assembled, double check the spacing between the Diaphragms.</td>
<td></td>
</tr>
<tr>
<td>a. Use a vehicle and chain connected to the front diaphragm to pull out the system if necessary.</td>
<td></td>
</tr>
<tr>
<td>b. Double check the correct seating of the Mushroom Washers as shown in Figure 25b.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Figure 28</td>
</tr>
</tbody>
</table>
**Detail 28b**

Nose Not Shown For Clarity

- 5/8" FLAT WASHER
- 5/8" X 1 1/4" HEX SOCKET BOLT
- SEE DETAIL 32c (INSIDE VIEW)
- PULLOUT BRACKET
- 5/8" RAIL NUT (Large)

**Detail 28a**

- 5/8" FLAT WASHER
- 5/8" X 2" HEX BOLT
- PULLOUT BRACKET

**Detail 28c**

- 5/8" FLAT WASHER
- 5/8" FLAT WASHER
- SEE DETAIL 32e
- CARTRIDGE SUPPORT BRACKET

**Detail 28d**

**Detail 28e**

Proper Placement of Bottom Front Cartridge Support Bracket

- TOTAL SIX 1/4-20 FASTENERS

**Detail 28f**

(Right Nose Cover Not Shown for Clarity)

- 118085G WASHER,LOCK,1/4,G
- 115946G NUT,HX,1/4,G

NOTE THE DIFFERENCE BETWEEN THE FRONT DIAPHRAGM BRACKET AND OTHERS. THE CARTRIDGE SITS LOWER ON THIS BRACKET THAN IN THE BAYS TO THE REAR. ALSO, THE BRACKET HAS A SUPPORT STIFFENER BUILT IN.
12. **Attach Cartridge Support Brackets**

1. Attach the Lower Cartridge Support Bracket to the front and back of all Diaphragms and the front of the Backup as shown in figures 30, 31, Diaphragm Assembly Drawing, page 62, and Tension Strut Backup Assembly Drawing, page 70.

   **Note:** The Face Plate of the Concrete Backup comes with Side Cartridge Support Brackets welded to it (see Figure 29).

   **Note:** 610 mm [24"] wide Systems do not have Side Cartridge Support Brackets, whereas 762 mm [30"] and 914 mm [36"] wide Systems have Side Cartridge Support Brackets welded to the Backup and Diaphragms.

2. Attach the Lower Support Bracket to the Tension Strut Backup. Use the Keeper to hold the Support Bracket in place. See Figure 30.
13. Checking the System Assembly
   1. Recheck that all fasteners are properly tightened throughout the System (anchor bolts, etc.). See the warning below.
   2. Check all Fender Panels. If they do not fit tightly against the underlying panel, System realignment may be necessary. See Figure 33.
WARNING: Anchor Studs: Torqued to 165 Nm [120 ft-lbs]
Should NOT protrude above nuts (see Figure 18)
All Other Bolts: Tightened
Fender Panel: Maximum gap allowed: 20 mm [0.78”]

---

14. Cartridge Placement
1. Be sure that the Front Diaphragm Bracket in the Nose is assembled correctly.
   See "Assemble Nose Assembly", step 11 and Detail 32c - 32f.
2. To complete the assembly of the QuadGuard® M10 TL-3 System, place the
   appropriate Cartridge in each Bay and the Nose section.
3. Place the type M-I Cartridges toward the front (Nose) of the System.
4. Place the type M-II Cartridges toward the rear (Backup) of the System.
5. See Figure 34.

---

WARNING: Placing the wrong Cartridge in the Nose or any Bay will result in
unacceptable crash performance as described in MASH.

---

www.highwayguardrail.com
www.energyabsorption.com
Revised November, 2011
All rights in copyright preserved
15. **Hold-Down Brace Assembly**
The Hold-Down Brace is used to contain the Nose Cartridge. Assemble it as shown in Figures 35 and 36.

**Figure 36**
*Typical Cartridge Layout*  
*(6 Bay System Shown)*
QuadGuard® M10 TL-3 Systems for Wide Hazards

System Assembly for Wide Hazards

Site Preparation/Foundation
A QuadGuard® M10 TL-3 System should be assembled only on an existing or freshly placed and cured concrete base (28 MPa [4000 psi] minimum). The location and orientation of the concrete base and attenuator must comply with project plans or as otherwise determined by the resident project engineer.

Caution: QuadGuard® M10 TL-3 Systems should never be anchored in asphalt.

Caution: Accurate placement of all steel rebar is critical to avoid interference with the concrete anchor bolts.

Recommended dimension and reinforcement specifications for new concrete pads are provided in the Energy Absorption Systems Concrete Pad Drawings supplied with the System. The System may be assembled on a reinforced concrete roadway (minimum 150 mm [6"] thick X 1.22 m [40"] wide X 6.4 m [21"] long). Cross slope shall not exceed 8% at the location of the system (see Figure 6, page 14) and should not vary (twist) more than 2% over the length of the System; the pad surface shall have a light broom finish.

www.highwayguardrail.com
www.energyabsorption.com

Revised November, 2011
All rights in copyright preserved
**WARNING:** Location of the Backup in relation to nearby objects will affect the operation of the attenuator. Upon impact, the Fender Panels telescope toward and extend beyond the rigid Backup as much as 760 mm [30"] from their pre-impact location. Position the Backup so that the rear ends of the last Fender Panels are a minimum of 760 mm [30"] forward of objects that would otherwise interfere with movement of the Panels. Failure to comply with this requirement will result in impaired System performance offering motorists less protection and cause component damage.

### System Assembly Procedures

<table>
<thead>
<tr>
<th>Step</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Determine Backup and Transition Type</strong></td>
</tr>
</tbody>
</table>

The System is available with a Tension Strut Backup or a Concrete Backup. See Figures 38a and 38b, along with the Concrete Backup Assembly Drawing, page 75, to determine which type of Backup is being assembled.

A Transition Panel or Side Panel will be used on each side of the Backup. A Side Panel is not needed when a Transition Panel is used. Several types of transitions are available for use with the QuadGuard® M10 TL-3 System. See Figures 39 through 43 and the drawing package to determine which type of panels are to be used.

---

*WIDTH VARIES*
- 1626 mm [64"] FOR 1755 mm [69"] WIDE SYSTEM
- 2100 MM [83"] FOR 2285 MM [90"] WIDE SYSTEM

---

*WIDTH VARIES*
- 1755 mm [69"]
- 2285 MM [90"]

---

**Figure 38a**  
_Tension Strut Backup_  

**Figure 38b**  
_Concrete Backup_
Figure 39
Transitioning the QuadGuard® M10 TL-3 System

Figure 40
No Transition

Figure 41
Quad-Beam™ to Safety Shape Barrier Transition Panel

Figure 42
Quad-Beam™ to Thrie-Beam Transition Panel

Figure 43
Quad-Beam™ to W-Beam Transition Panel

QUAD-BEAM™ TO W-BEAM TRANSITION PANEL
WHEEL DEFLECTORS MAY BE REQUIRED FOR BIDIRECTIONAL APPLICATIONS.
**Transition Panel Types:** The proper Transition or Side Panel must be used for accepted impact performance of the System. The correct panel to use will depend on the direction of traffic and what type of barrier or hazard the QuadGuard® M10 TL-3 System is shielding. Contact the Customer Service Department prior to system assembly if you have any questions.

**WARNING:** Only Strong Soil, AASHTO M147 with static performance >90% is to be used with the assembly of a transition in soil.

**WARNING:** Only steel posts with wood blocks are to be used for the Quad-Beam™ to W-Beam or Quad-Beam™ to Thrie-Beam Transition.

2. **Mark the System Location**
   1. Locate the centerline of the System by measuring the proper offset from the hazard.
      a. See the drawing package supplied with the System.
   2. Place a chalk line to mark the centerline of the System.
   3. Mark a construction line parallel to the center line and offset it 165 mm [6.5"] to one side as shown in Figure 44.
   4. The edge of the Monorail will be placed on this line.

   **Note:** The concrete pad should be assembled per the project plans supplied with the System and this Manual.

**WARNING:** Location of the System with respect to the hazard is critical and dependent on the type of Transition Panel used. See the project plans supplied with the System for details.

3. **Anchor the Backup**

   **3a. Concrete Backup Assembly** (Figure 45)
   1. Locate the front Face Plate using the Concrete Backup Assembly Drawing, page 68.
   2. Drill four 22mm [7/8"] X 125mm [5"] anchor holes in the Concrete Backup using the Face Plate as a template.
   3. Anchor the Face Plate to the Concrete Backup using the MP-3® Anchoring System (horizontal kit) supplied with the QuadGuard® M10 TL-3 System (see "MP-3® Polyester Anchoring System" section, page 44).

   **WARNING:** Every hole and slot in Backup and Monorail must have an MP-3® bolt anchoring it.
### Tension Strut Backup Assembly (Figure 46)

1. Locate the Tension Strut Backup with the attached Monorail on the pad with the side of the attached Monorail on the construction line and rear edge of the Backup Foot 100 mm [4"] forward of the edge of the pad (see Figure 48).
2. Verify that any applicable Transition Panels fit properly before anchoring the Backup.
3. Drill Eighteen 22mm [7/8"] X 140mm [5 ½"] anchor holes in the pad using the Backup as a template.
4. Anchor the Backup to the concrete pad using the MP-3® Vertical Kits provided. (See “MP-3® Polyester Anchoring System” section, page 44).

### Monorail Assembly for Concrete Backup

5. Locate the Monorail on the pad with the side of the Monorail on the construction line and rear edge of the Monorail Foot 255mm [10"] forward of the front face of the Concrete Backup (see Figure 49 and the Monorail Assembly Drawing page 82 to 84).
6. Orient the Monorail so that the Monorail Tongues face the Backup (see Figure 18).
7. Drill 22mm [7/8"] X 140 mm [5 1/2"] deep anchor holes in the pad using the Monorail as a template (see Figure 49). Do not drill through the pad.
8. Anchor each Monorail section using the MP-3® Vertical Kits provided. See Figure 18 and the MP-3® Polyester Anchoring System Instructions, page 44. It is important to place each segment of Monorail in alignment from the back to the front of the System (+/- 6 mm [1/4"]).

**WARNING:** Improper alignment at the Monorail splice joints will prevent proper System collapse during an impact (see Figure 18, Detail A, page 18).
4b. Monorail Assembly for Tension Strut Backup (Figure 48)
1. Locate the Monorail on the pad with the side of the Monorail on the construction line (see Figure 48 and the Monorail Assembly Drawing page 82 to 84).
2. Orient the Monorail so that the Monorail Tongues face the Backup (see Figure 47).
3. Drill 22mm [7/8"] X 140 mm [5 1/2"] deep anchor holes in the pad using the Monorail as a template (see Figure 48). Do not drill through the pad.
4. Anchor each Monorail section using the MP-3® Vertical Kits provided. See Figure 18 and the MP-3® Polyester Anchoring System Instructions, page 44. It is important to place each segment of Monorail in alignment from the back to the front of the System (+/- 6 mm [1/4"]).

Figure 47
Proper Stud Height/Monorail Alignment

Figure 48
Backup and Monorail Location for Tension Strut Backup

Figure 49
Monorail Location for Concrete Backup

Figure 50
Rail Nuts are Oversize
5. **Assemble Side Panels and/or Transition Panels to the Backup Assembly**

1. Attach the Hinge Plate to the Transition Panel or Side Panel using 5/8” rail bolts and 5/8” rail nuts (large) (two places - top and bottom holes only). See figure 51.

2. Attach the Transition Panel or Side Panel assembly to the side of the Backup using 5/8” hex bolts, 5/8” lock washers, and 5/8” hex nuts (small) (three places each side of the Backup). See Figure 51.

3. Attach the Diagonal Brace to the Side Panel and Backup using 3/8” hex bolts, 3/8” lock washers, and 3/8” hex nuts (four places per brace; eight places per side).

4. Secure each Diagonal Brace with 3/8” hex bolts, 3/8” lock washers, and 3/8” hex nuts (two places per Brace) as shown in Figure 51.

**Assembly tip:** Use a drift pin to align the center hole of the Panel with the center hole of the Hinge Plate before attaching the rail bolts.

**Note:** A Side Panel is not needed when a Transition Panel is used. Diagonal braces are not used with some Transition Panels. See the supplied drawing package.

**Note:** Do not mix the 5/8” rail nuts (large) with the 5/8” hex nuts (small). See Figure 50.

---

**Figure 51**

*Side Panel/Transition Panel Attachment*
### 6. Assemble Monorail Guides

Attach Monorail Guides to Diaphragm as follows:

1. Insert 3/4” x 2” G8 hex bolts through the Monorail Guide and Diaphragm oriented as shown in Figure 52.
2. The Diaphragm Shims are sandwiched between the Rail Guide and Diaphragm. Also see the Diaphragm Shim Kit Drawing, page 63.
4. Repeat this for each Diaphragm.

---

### 7. Assemble Diaphragms

1. Orient the widest Diaphragm so that the front face of the Quad-Beam™ shape faces toward the nose of the System as shown in Figure 53.
   a. **The widest Diaphragm must be assembled closest to the Backup with each subsequent Diaphragm being progressively narrower.**
2. Slide all Diaphragms on the monorail.
3. Slide all Diaphragms all the way back to ensure the System is able to collapse properly during impact.
   a. Each diaphragm should slide smoothly without any hang ups.
4. After Step 3a has been verified, slide each Diaphragm forward to approximately 915 mm [36”] in front of each other as shown in Figure 54.
8. **Attach Hinge Plates onto Fender Panels**

   **Note:** For proper impact performance, Systems for wide hazards must have Hinge Plates.

   Attach a Hinge Plate to each Fender Panel using two 5/8" rail bolts and two 5/8" rail nuts (large), using the top and bottom holes only, leaving the center hole open as shown in Figure 55.

9. **Assemble Fender Panels**

   1. Starting at the last bay, attach the left and right Fender Panels as shown in Figure 56c.
   2. Attach the Hinge Plate at the front of the Fender Panels to the Diaphragm in front using three 5/8" hex bolts, rail nuts (large), and washers. See the Diaphragm Assembly Drawing, page 71-72.
   3. Attach the Mushroom Washer Assembly as shown in Details 56a and 56b but do not tighten at this time.
   a. Be sure the Mushroom Washer lays flat against the Fender Panel as shown in Detail 56b. The standoff on the Washer must be seated completely through the slot.
   4. Check the Diaphragm spacing to ensure there is 915 mm [36"] between the rear faces of consecutive Diaphragms as shown in Figure 57.
   5. After the proper spacing has been achieved, tighten the Mushroom Washer Assembly (small hex) nuts until they reach the end of the threads to hold the Diaphragm and Fender Panels in place during assembly of the rest of the System.
   6. Attach the remaining Fender Panels following the same procedures as described in steps 2 thru 5.
Detail 56a  
*Mushroom Washer Assembly*

Detail 56b  
*Mushroom Washer Orientation*

Figure 56c  
*Fender Panel Assembly*
10. **Attach End Cap**
   Using 5/8" x 3 1/2" G5 hex bolts, 5/8" hex nuts (small), and 5/8" lock washers, attach the End Cap to the front of the first Monorail segment as shown in Figure 58 and the Monorail Assembly Drawing, page 82-84.

11. **Assemble Nose Assembly**
   1. Attach the Nose to the front Diaphragm, as shown in Figure 59 and Details 59a and 59b, and the Nose Assembly Drawing, page 73, using six hex socket bolts which also hold the front two Fender Panels to the Diaphragm Hinge Plate with a flat washer under each bolt.
   2. Attach the Pullout Brackets to the front Diaphragm as shown in Detail 59a.
Detail 59a

5/8" RAIL NUT (LARGE)

PULLOUT BRACKET (NO WASHER)

5/8" X 2" HEX BOLT

5/8" X 1 1/2" G5 HEX BOLT

5/8" RAIL NUT (LARGE)

5/8" FLAT WASHER

5/8" X 1 1/4" HEX SOCKET BOLT

Detail 59b

TOTAL SIX
1/4-20 FASTENERS *

* 113518G BOLT,HX,1/4X3/4,G2,P
118089G WASHER,LOCK,3/4,G
115946G NUT,HX,1/4,G

Detail 59c

Proper Placement of Bottom Front Cartridge Support Bracket.

Proper Placement of Bottom Front Cartridge Support Bracket
(Right Nose Cover Not Shown for Clarity)

NOTE THE DIFFERENCE BETWEEN FRONT DIAPHRAGM BRACKET AND OTHERS. THE CARTRIDGE SITS LOWER ON THIS BRACKET THAN IN THE BAYS TO THE REAR. ALSO, THE BRACKET HAS A SUPPORT STIFFENER BUILT IN.
12. **Check System Spacing**  
After the entire System has been assembled, double check the spacing between the Diaphragms. Use a vehicle and chain connected to the front diaphragm to pull out the system if necessary. Double check the correct seating of the Mushroom Washers as shown in Figure 25b.

13. **Attach Cartridge Support Brackets**  
1. Attach the Cartridge Support Brackets to all the Diaphragms and Backup as shown in Figures 60, 61 and 62, the Concrete Backup Assembly Drawing, page 75, and the Diaphragm Assembly Drawing pages 71-72.  
2. Attach the Lower Cartridge Support Bracket. See Figure 62.  
3. Attach the Lower Support Bracket for the Tension Strut Backup. Use the Keeper to hold the Support Bracket in place. See Figure 60.

---

**Figure 60**  
*Tension Strut Backup with Cartridge Support Bracket*  

**Figure 61**  
*Concrete Backup with Cartridge Support Bracket*  

**Figure 62**  
*Diaphragm with Cartridge Support Bracket*
14. **Checking the System Assembly**

1. Recheck the System to ensure that all fasteners are properly tightened throughout the System (anchor bolts, etc.). See the warning below.
2. Check all Fender Panels. If they do not fit tightly against the underlying panel, System realignment may be necessary. See Figure 63.

### IMPORTANT:

- **Anchor Studs:** Torqued to 165 Nm [120 ft-lbs]
  - Should NOT protrude above nuts (see Figure 17)
- **All Other Bolts:** Tightened Snugly
- **Fender Panel:** Maximum gap allowed: 25 mm [1.00"] (see Figure 63)

![Fender Panel Gap for Wide Systems](image)

**MAXIMUM GAP = 25 mm [1.00"]**

**Figure 63**

Fender Panel Gap for Wide Systems

*(Right Nose Cover Not Shown for Clarity)*

15. **Cartridge Placement**

1. Be sure the Front Diaphragm Bracket in the Nose is assembled correctly. See instruction step 11, "Assemble Nose Assembly" page 39.
2. To complete the assembly of a QuadGuard® M10 TL-3 System, place the appropriate Cartridge in each Bay and Nose section of the System.
3. Place type M-I Cartridges toward the front (Nose) of the System. See Figure 64.
4. Place type M-II Cartridges toward the rear (Backup) of the System. See Figure 64.

**WARNING!** Placing the wrong Cartridge in the Nose or any Bay may result in unacceptable crash performance as described in MASH.

![Typical Cartridge Layout-TL-3](image)

**Figure 64**

*Typical Cartridge Layout-TL-3*
16. **Hold-Down Brace Assembly**  
The Hold-Down Brace is used to contain the Nose Cartridge. Assemble it as shown in Figure 65 and 66.

| 3/8" HEX | 3/8"x2" FLAT WASHER | HOLD-DOWN BRACE |
| 3/8"x1" FLAT WASHER | 3/8" HEX | STEEL NOSE |
| 3/8" HEX BOLT | 3/8" HEX | 3/8" HEX NUT |

**Detail 65**  
*Proper Placement of Hold-Down Brace*

**Figure 66**  
*Typical Cartridge Layout (6 Bay System Shown)*
# MP-3® Polyester Anchoring System

The MP-3® Polyester Anchoring System is a quick and easy way to securely anchor crash cushions and other common highway devices. MP-3® features high pullout strength, superior vibration resistance, and exceptional durability.

Each MP-3® Kit contains a can of MP-3® Resin, Hardener, Cold Weather Promoter, studs, washers, and a complete safety sheet. The cold weather promoter shortens hardening time by as much as seven hours. Both vertical and horizontal assemblies are possible using the MP-3® System.

<table>
<thead>
<tr>
<th></th>
<th><strong>1. Shelf life</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>If the shelf life of the MP-3® has expired (see MP-3® Kit for expiration information), mix a small amount of MP-3® in the proportions of one part A to two parts B by volume. If the material does not set according to the instructions, contact Energy Absorption Systems for guidance.</td>
</tr>
</tbody>
</table>

**WARNING:** Do not use the MP-3® if the material fails to set up, Part A-Resin has gelled (for vertical applications), or TX-Resin is NOT gelled (for horizontal applications).

<table>
<thead>
<tr>
<th></th>
<th><strong>2. Steel rebar</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>If steel rebar is encountered while drilling an MP-3® anchor bolt hole, apply one of the following solutions:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th><strong>2a.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Drill a new hole down at an angle past the rebar to the proper depth.</td>
</tr>
<tr>
<td>2.</td>
<td>Anchor the stud by completely filling both holes with MP-3®.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th><strong>2b.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Using a diamond core drill or rebar drilling tool, drill through the rebar only, then switch back to the concrete bit and drill into the underlying concrete until the proper hole depth is reached. (See caution Below)</td>
</tr>
</tbody>
</table>

**Caution:** Do not drill through rebar without first obtaining permission to do so from the local project engineer.
## Vertical Assemblies

Note: Read MP-3® Instructions before starting.

<table>
<thead>
<tr>
<th>Step</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Prepare the concrete pad</strong> 1. The anchor bolts (studs) that anchor the QuadGuard® M10 TL-3 System to the concrete pad must be those shipped in the Kit or of high strength steel (minimum 830 MPa [120,000 psi] tensile strength or equal). 2. These studs must be set in minimum 28 MPa [4000 psi] concrete. 3. Allow the concrete to cure a minimum of 7 days before assembling the MP-3®.</td>
</tr>
<tr>
<td></td>
<td><strong>WARNING:</strong> Do not allow the MP-3® Resin or Hardener to contact skin or eyes. See material safety data sheet supplied with the MP-3® Kit for first-aid procedures. Use only in well-ventilated area. Do not use near open flame.</td>
</tr>
<tr>
<td></td>
<td><strong>WARNING:</strong> The QuadGuard® M10 TL-3 System must not be anchored on asphalt.</td>
</tr>
<tr>
<td></td>
<td><strong>WARNING:</strong> Wear safety goggles and gloves during System assembly.</td>
</tr>
</tbody>
</table>
| 2. | **Drill holes**  
**Note:** Energy Absorption Systems recommends using two-fluted drills to achieve optimum tensile strength when assembling the MP-3® Anchoring System. Full strength will not be achieved if a diamond drill is used. 1. Use the part to be anchored as a drilling template. 2. Drill the holes 3 mm [1/8"] larger than the stud diameter to the recommended depth using a rotary percussive drill. See the MP-3® Assembly Instructions provided with your Kit. 3. Check to be sure all holes are drilled to the proper depth and aligned with the part to be anchored. See Table A. |
|     | **Table A, MP-3® Anchoring Information**

<table>
<thead>
<tr>
<th>Stud size</th>
<th>Concrete Bit size</th>
<th>Minimum Depth</th>
<th>Recommended Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4&quot; x 7&quot;</td>
<td>22 mm [7/8&quot;]</td>
<td>125 mm [5 1/2&quot;]</td>
<td>165 Nm [120 ft-lbs]</td>
</tr>
<tr>
<td>3.</td>
<td><strong>Clean the holes</strong> 1. Blow the concrete dust from the hole, using oil-free compressed air. 2. Thoroughly brush it with a stiff bristled brush and then blow it out again. 3. If the hole is wet, completely flush it with water while brushing. Then blow it clean using oil-free air.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td><strong>Position the part to be anchored</strong> Position the part to be anchored so that the holes in the part are aligned with the drilled holes in the concrete.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. **Mix the resin and hardener**
   1. Wearing gloves and safety goggles, remove the lids from the MP-3® Part A-Resin and Part B-Hardener containers.
   2. Pour Part B into Part A and then mix vigorously for 30 seconds to form MP-3® Grout (an anchor stud may serve as a stirring rod).

6. **Add cold weather promoter (in cold weather)**
   For faster hardening in cold weather, the Promoter may be used.
   Add the entire contents of the partially filled Promoter container to the MP-3® Grout and then mix it for an additional 30 seconds. Use immediately because the MP-3® Grout will thicken quickly. See Table B for hardening times.

   **WARNING:** Do not use Promoter when the temperature is above 15 degrees Celsius (60 degrees Fahrenheit). Grout will harden too quickly.

7. **Pour grout into holes**
   1. Crimp the mouth of the can to form a spout, and pour the MP-3® Grout mixture down into the hole through the part to be anchored.
   2. Fill the hole 1/3 to 1/2 full.

   **Caution:** Do not overfill or under fill the hole. If the hole is overfilled, there will not be enough grout to use all of the anchor studs in the kit. If hole is under-filled, the grout may not develop the required pull out strength.

8. **Add the washers and nuts**
   Place a flat washer onto a stud and then thread a nut on it until 1 or 2 threads of the nut are left exposed.

9. **Insert Studs in holes and wait for grout to harden**
   1. Push the stud down through the part to be anchored and into the hole.
   2. Give the stud several twists in the MP-3® to wet the threads.
   3. See Table B for hardening times.

   **Caution:** Do not disturb or load the stud until the MP-3® material has hardened (see Table B for hardening times).

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>No Promoter</th>
<th>With Promoter</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;26  &gt;80</td>
<td>1/2</td>
<td>N/R*</td>
</tr>
<tr>
<td>22-26 70-79</td>
<td>1</td>
<td>N/R*</td>
</tr>
<tr>
<td>16-21 60-69</td>
<td>2</td>
<td>N/R*</td>
</tr>
<tr>
<td>10-15 50-59</td>
<td>4</td>
<td>3/4</td>
</tr>
<tr>
<td>4-9  40-49</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>-1-3 30-39</td>
<td>N/R*</td>
<td>1 1/2</td>
</tr>
<tr>
<td>&lt;-1  &lt;30</td>
<td>N/R*</td>
<td>N/R*</td>
</tr>
</tbody>
</table>

* Not recommended. Contact Energy Absorption Systems Customer Service Department for more information.

10. **Torque the nuts**
   1. After the Grout has hardened (see Table B for hardening time), torque the nuts to the recommended value. (See Table A.)
   2. No threads of the nut should be exposed.
Horizontal Assemblies
The Horizontal MP-3® Kit is the same as the Vertical Kit except that a cartridge for a standard caulking gun is supplied in the Horizontal Kits and the resin for the Horizontal Kits is a thixotropic (TX) resin and the anchor bolts are 6 ½” long instead of 7”. The TX-Resin is a gelled resin designed to keep the grout in place in horizontal holes during the system assembly process.

Note: Read MP-3® instructions before starting.

**WARNING:** Do not allow the MP-3® Resin or Hardener to contact skin or eyes. See material safety data sheet supplied with the MP-3® kit for first-aid procedures. Use only in well-ventilated area. Do not use near open flame.

**WARNING:** Wear Safety Goggles and Gloves during system assembly.

<table>
<thead>
<tr>
<th>Step</th>
<th>Actions</th>
</tr>
</thead>
</table>
| 1. Prepare the concrete pad | 1. The anchor bolts (studs) that anchor the QuadGuard® M10 TL-3 System to the vertical surface (such as the Concrete Backup or CMB for transitions) must be those shipped in the Kit or of high strength steel (minimum 830 MPa [120,000 psi] tensile strength or equal). See table A.  
2. These studs must be set in minimum 28 MPa [4000 psi] concrete.  
3. Allow the concrete to cure a minimum of 7 days before assembling MP-3®. |
| 2. Drill holes | **Note:** Energy Absorption Systems recommends using two-fluted drills to achieve optimum tensile strength when assembling the MP-3® anchoring system. Full strength will not be achieved if a diamond drill is used.  
1. Use the part to be anchored as a drilling template.  
2. Drill the holes 3 mm [1/8"] larger than the stud diameter to the recommended depth using a rotary percussive drill. See the MP-3® Assembly Instructions provided with your kit.  
3. Check to be sure all holes are drilled to the proper depth and aligned with the part to be anchored. See Table A. |
| 3. Clean the holes | 1. Blow the concrete dust from the hole, using oil-free compressed air.  
2. Thoroughly brush it with a stiff bristled brush and then blow it out again.  
3. If the hole is wet, completely flush it with water while brushing. Then blow it clean using oil-free air. |

<table>
<thead>
<tr>
<th>Table A, MP-3® Anchoring Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stud size</strong></td>
</tr>
<tr>
<td>3/4” x 6 1/2”</td>
</tr>
<tr>
<td>Step</td>
</tr>
<tr>
<td>------</td>
</tr>
</tbody>
</table>
| 4.   | **Position the part to be anchored**  
Position the part to be anchored so that the holes in the part are aligned with the drilled holes in the concrete. |
| 5.   | **Thread the dispensing tip onto dispenser**  
Prior to mixing the Grout, carefully thread the dispensing tip onto the dispenser. |
| 6.   | **Mix the Resin and Hardener**  
1. Wearing gloves and safety goggles, remove the lids from the MP-3® Part A-Resin and Part B-Hardener containers.  
2. Pour Part B into Part A and then mix vigorously for 30 seconds to form MP-3® Grout (an anchor stud may serve as a stirring rod). |
| 7.   | **Add cold weather promoter (in cold weather)**  
For faster hardening in cold weather the Promoter may be used.  
Add the entire contents of the partially filled Promoter container to the MP-3® Grout and then mix it for an additional 30 seconds. Use immediately because the MP-3® Grout will thicken quickly. See Table B for hardening times.  
**WARNING:** Do not use Promoter when the temperature is above 15 degrees Celsius (60 degrees Fahrenheit). Grout will harden too quickly. |
| 8.   | **Pour mixed grout into dispenser**  
1. Once the Grout is mixed, crimp the mouth of the can to form a spout and pour the MP-3® Grout into the open end of the dispenser (use a mixing stud to scrape out the portion remaining in the can).  
2. You may use the box to hold the dispenser upright. Close the box lid and poke the dispenser tip into the top of it.  
3. Seal the dispenser with the plunger provided. |
| 9.   | **Place the dispenser in caulking gun and dispense grout**  
1. Cut off the small end of the dispenser tip.  
2. Place the dispenser into a caulking gun and dispense the MP-3® TX Grout until it reaches the tip of the dispenser and then release the pressure.  
3. Push the dispenser tip through the part to the bottom of the hole and dispense it while slowly withdrawing the tip.  
**Caution:** Do not overfill or under fill the hole. Fill hole approximately 1/3 to 1/2 full. If the hole is overfilled, there will not be enough Grout to use all of the anchor studs. If the hole is under filled the Grout may not develop the required pull out strength. |
| 10.  | **Add the washers and nuts**  
Place a flat washer onto a stud and then thread a nut on it until 1 or 2 threads of the nut are left exposed. See Figure 66. |
Maintenance and Repair

Inspection Frequency
Inspections are recommended as needed based upon the volume of the traffic and impact history and approval by the appropriate highway authority. Visual Drive-By Inspections are recommended at least once a month. Walk-Up Inspections are recommended at least once a year.

Visual Drive-By Inspection

<table>
<thead>
<tr>
<th>Step</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Check to see if there is evidence of a hit. If so, a walk-up inspection will be necessary.</td>
</tr>
<tr>
<td>2.</td>
<td>Check to see if any Cartridge appears to be off the support bracket. Any damaged Cartridges will need to be replaced.</td>
</tr>
</tbody>
</table>

**WARNING:** See Cartridge Placement Section, page 27 and 42.

3. Be sure the steel nose is in place.

4. Note the location and condition of the QuadGuard® M10 TL-3 System and the date of visual drive-by inspection.

Table B, Approximate Hardening Times (Hours)

<table>
<thead>
<tr>
<th>Temperature (°C) (°F)</th>
<th>No Promoter</th>
<th>With Promoter</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;26 &gt;80</td>
<td>1/2</td>
<td>N/R*</td>
</tr>
<tr>
<td>22-26 70-79</td>
<td>1</td>
<td>N/R*</td>
</tr>
<tr>
<td>16-21 60-69</td>
<td>2</td>
<td>N/R*</td>
</tr>
<tr>
<td>10-15 50-59</td>
<td>4</td>
<td>3/4</td>
</tr>
<tr>
<td>4-9 40-49</td>
<td>8</td>
<td>1 1/2</td>
</tr>
<tr>
<td>-1-3 30-39</td>
<td>N/R*</td>
<td>N/R*</td>
</tr>
<tr>
<td>&lt;-1 &lt;30</td>
<td>N/R*</td>
<td>N/R*</td>
</tr>
</tbody>
</table>

* Not recommended. Contact Energy Absorption Systems Customer Service Department for more information.
### Walk-Up Inspection

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Clear and dispose of any debris on the site.</td>
</tr>
<tr>
<td>2.</td>
<td>Make sure all bolts are tight.</td>
</tr>
<tr>
<td>3.</td>
<td>Make sure that the concrete anchor bolts are securely anchored.</td>
</tr>
<tr>
<td>4.</td>
<td>Make sure that the Diaphragm legs are straight.</td>
</tr>
<tr>
<td>5.</td>
<td>Make sure that all Mushroom Washer Assemblies are properly aligned and positioned.</td>
</tr>
<tr>
<td>6.</td>
<td>Make sure that all Fender panels and Transition Panels nest tightly against the System.</td>
</tr>
</tbody>
</table>

**WARNING:** Fender Panel Maximum gap allowed: Narrow Systems 20 mm [0.78”], Wide Systems 25 mm [1.00”] (See Figures 68 and 69).

**Figure 68**
*Fender Panel Gap for Narrow Systems*

**Figure 69**
*Fender Panel Gap for Wide Systems*

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 7.   | 1. Make sure that the cartridges have not been damaged and are properly positioned on their support brackets.  
2. Replace crushed or damaged cartridges.  
**NOTE:** To ensure 100% of the full performance as tested per MASH and accepted by FHWA, partially crushed cartridges (due to slow speed impacts or nuisance hits) should be replaced. See the Cartridge placement in figure 34, page 27 or figure 64, page 42. |
| 8.   | Make all necessary repairs as described above. See section “Post-Impact Instructions” for more information. |
| 9.   | 1. Note the location and condition of the QuadGuard® M10 TL-3 System and any work done in the Impact Attenuator Inspection Logbook under the date of this inspection.  
2. If further repair is necessary, note the repair request date in the logbook. See the “Post Impact Instructions,” and the System assembly section of this Manual for more information. |

### Post-Impact Instructions for Narrow Hazards

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Deploy the appropriate traffic-control devices to protect your crew.</td>
</tr>
</tbody>
</table>
| 2.   | Check to see that all anchor bolts have remained firmly anchored in the roadway surface.  
**Note:** Failed anchor bolts are those found to be loose, broken, or showing signs of pull-out and must be replaced. |
### 3. Clear and dispose of any debris on the site.

### 4. Check the System to be certain that the Mushroom Washer Assemblies holding the Fender Panels together are still intact and that the System has not been deformed in a way that would prevent pulling it back to its original position.

### 5. Make sure that the Diaphragm support legs are all properly attached to the Monorail.

### 6. 
1. Attach a chain through the pullout brackets on the first Diaphragm (see Figure 70).
2. Attach the other ends of the chain to a heavy vehicle (such as a 1-ton pickup).

**WARNING:** Stand clear in case chain breaks or becomes disconnected

### 7. 
1. Pull the QuadGuard® M10 TL-3 System forward slowly until the System reaches its original length. Have someone watch the System during repositioning to be certain previously undetected damage does not cause the Diaphragms to bind or pull out improperly.

### 8. Remove all crushed cartridges from within the System and discard them.

**WARNING:** Do NOT use any cartridge that shows signs of damage. Doing so could affect the System performance.

### 9. Check to see that the Diaphragms are in usable condition. Diaphragms which are bowed or have bent legs must be replaced.

### 10. Check that the Fender Panels are properly attached with the Mushroom Washer Assemblies. Damaged Fender Panels and Transition Panels must be replaced.

### 11. Check Cartridge Support Brackets.

Often Cartridge Support Brackets with minor damage can be straightened and reused by doing the following:

1. Remove the damaged Cartridge Support Bracket from the Diaphragm.
2. Clamp the Cartridge Support Bracket to the Backup and begin bending it using a pipe wrench as shown in Figure 70.
3. Using a sledge hammer and Quad-Beam™ shape on Backup as an anvil, form the Cartridge Support Bracket back into a 90° shape (see Figure 72).

---

**Figure 70**
Pullout Brackets for Narrow Systems
12. Check gaps between Fender Panels.
   1. The maximum gap allowed for these overlapping parts (including Fender Panels
      overlapping panels behind the System) is 20 mm [0.78"] for Narrow Systems (see
      Figure 68).
   2. Be sure the Mushroom Washer Assemblies are tightened so that the spring is
      compressed. If the gaps between the Fender Panels are still too large it may be
      necessary to replace bent parts.

13. Replace all crushed cartridges. See Figure 76, page 56 for Cartridge placement.

14. 1. Remove the damaged Nose Assembly.
   2. Attach the new nose to the first Diaphragm, using the six rail bolts, coupling nuts,
      rail nuts, cap screws, pull-out brackets that hold the Nose to the first Diaphragm
      (refer to instruction 10 on page 23).
   3. The top and bottom holes of the Nose Cover are slotted to provide adjustment.
   4. Adjust the Nose to align it with the Fender Panels and then torque all six nuts to 35
      Nm [25 fl-lbs].
   5. Place the Nose Cartridge.
   6. Assemble the Hold-Down Brace as shown in Figure 35, page 27.

15. Check the torque of all bolts on the System (see Table C).

Table C

| IMPORTANT: | Torqued to 165 Nm [120 fl-lbs.] | Should NOT protrude above nuts (see Figure 18) |
| Max. Stud height: | 40 mm [1.50"] | |
| All Other Bolts: | Tightened | |
| Fender Panel: | Maximum gap allowed: 20 mm [0.78"] | |
## Post-Impact Instructions for Wide Hazards

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Deploy the appropriate traffic-control devices to protect your crew.</td>
</tr>
<tr>
<td>2.</td>
<td>Check to see that all anchor bolts have remained firmly anchored in the roadway surface. Replace any that are loose, broken, or pulled out. The proper performance of the System during an angle impact depends on the Monorail anchors being properly anchored.</td>
</tr>
<tr>
<td>3.</td>
<td>Caution: QuadGuard® M10 TL-3 Systems for Wide Hazards should never be anchored to asphalt.</td>
</tr>
<tr>
<td>4.</td>
<td>Clear and dispose of any debris on the site.</td>
</tr>
<tr>
<td>5.</td>
<td>Check the System to be certain that the Mushroom Washer Assemblies holding the Fender Panels together are still intact and that the System has not been deformed in a way that would prevent pulling it back to its original position.</td>
</tr>
<tr>
<td>6.</td>
<td>Be sure that the Diaphragm Support Legs are all properly attached to the Monorail.</td>
</tr>
<tr>
<td>7.</td>
<td>Attach a chain to the pullout brackets on the first Diaphragm (see Figure 73). Attach both ends of the chain to a heavy vehicle (such as a 1-ton pickup).</td>
</tr>
<tr>
<td>8.</td>
<td>WARNING: Stand clear of the System and the vehicle in case the chain breaks or becomes disconnected.</td>
</tr>
<tr>
<td>9.</td>
<td>Pull the QuadGuard® M10 TL-3 System forward slowly until the System reaches its original length. Have someone watch the System during repositioning to be certain previously undetected damage does not cause the Diaphragms to bind or pull out improperly.</td>
</tr>
</tbody>
</table>

**Figure 73**

*Pullout Brackets for Wide Systems*
8. Remove all crushed Cartridges from within the System and discard them.

**WARNING:** Do NOT use any cartridge that shows signs of damage. Doing so could affect the System performance.

9. Check to see that the Diaphragms are in usable condition. Diaphragms which are bowed or have bent legs must be replaced.

10. Check that the Fender Panels are properly attached with the Mushroom Washer Assemblies. Damaged Fender Panels and Transition Panels must be replaced.

11. Check Cartridge Support Brackets.
   Often Cartridge Support Brackets with minor damage can be straightened and reused by doing the following:
   1. Remove damaged Cartridge Support Bracket from the Diaphragm.
   2. Clamp the Cartridge Support Bracket to the Backup and begin bending using a pipe wrench as shown in Figure 74.
   3. Using a sledge hammer and Quad-Beam™ shape on the Backup as an anvil, form the Cartridge Support Bracket back into a 90° shape (see Figure 75).

**WARNING:** Maximum gap allowed on Wide Systems Fender Panel overlap: 25 mm [1.00"] (see Figure 69, page 50).

12. Check gaps between Fender Panels.
    1. The maximum gap allowed for these overlapping parts (including Fender Panels overlapping panels behind the System) is 25 mm [1.00"] (see Figure 68).
    2. Be sure the Mushroom Washer Assemblies are tightened so that the spring is compressed. If the gaps between the Fender Panels are still too large it may be necessary to replace bent parts.

13. Replace all crushed cartridges. See Figure 76 for Cartridge placement.

14. 1. Remove the damaged Nose Assembly.
    2. Attach the new nose to the first Diaphragm, using the six rail bolts, coupling nuts, rail nuts, cap screws, and Pull-out Brackets that hold the nose to the first Diaphragm.
3. The top and bottom holes of the Nose Cover are slotted to provide adjustment.
4. Adjust nose to align with Fender Panels, then torque all six nuts to 35 Nm [25 fl-lbs].
5. Place Nose Cartridge.
6. Assemble the Hold-Down Brace as shown in Figure 36.

16. Check the torque of all bolts on the System (see Table C).

**Table C**

**IMPORTANT:**
- Anchor Studs: Torqued to 165 Nm [120 fl-lbs.)
- Should NOT protrude above nuts (see Figure 18)
- All Other Bolts: Tightened
- Fender Panel: Maximum gap allowed: 25 mm [1.00"] for Wide Systems.

17. Check to be certain that the site is free from any debris.
The QuadGuard® M10 TL-3 System is ready for use.

**Parts Ordering Procedure**

Make a list of all damaged parts using part descriptions shown in Figures 76 and 77. Answer the following questions in the spaces provided. This information is necessary to receive the proper parts.

**Table D: QuadGuard® M10 TL-3 System Ordering Information Chart**

<table>
<thead>
<tr>
<th>Description</th>
<th>Choices</th>
<th>Fill In This Section</th>
</tr>
</thead>
</table>
| What is the Width of System? (See "Measuring the Width"). | 610 mm [24"]  
760 mm [30"]  
915 mm [36"]  
1755 mm [69"]  
2285 mm [90"] |                                    |
| What is the Number of Bays? (See "Counting the Number of Bays"). | Narrow Hazards: 1 through 12  
Wide Hazards: 3 through 12 |                                    |
| What Type of Backup Does the System Have? | Concrete or Tension Strut |                                    |
| What Type of Transition Panel? (See "Side Panel and Transition Panel Types"). Be sure to note right side, left side, both sides, or no transitions. (See "How to Determine Left/Right") | • Quad to W  
• Quad to Thrie  
• Quad to Safety Shape Barrier  
• Quad to End Shoe  
• 4" Offset Panel |                                    |
Figure 76

QuadGuard® M10 for Narrow Hazards
Figure 77
QuadGuard® M10 for Wide Hazards

www.highwayguardrail.com
www.energyabsorption.com

Revised November, 2011
All rights in copyright preserved
Appendix

Narrow System - Concrete Backup
Reference DWG QGMCBCVR-U
Narrow System – Tension Strut Backup
Reference DWG QGMTSCVR-U
Diaphragm Shim Kit
Reference DWG 614050
Nose Assembly - Narrow System
Reference DWG 617385

www.highwayguardrail.com
www.energyabsorption.com
Fender Panel Assembly - Narrow System
Reference DWG 608236

www.highwayguardrail.com
www.energyabsorption.com

Revised November, 2011
All rights in copyright preserved

65
Concrete Backup on Grade - Narrow System

Reference DWG 354008, Sh. 1

MONOLITH TOP VIEW
REINFORCEMENT DETAIL

MONOLITH SIDE VIEW
REINFORCEMENT DETAIL

FRONT VIEW

PARTS LIST

NOTES:
1. BACKUP MUST BE ABLE TO WITHSTAND A MAXIMUM
   OVERTURNING MOMENT OF 230 kNm [2000 KF-FT] AT DECK
   LINE FOR A DURATION OF 40s.
2. 29 MPa [4100 PSI] PORTLAND CEMENT CONCRETE REQUIRED.
3. LINEAR TOLERANCES TO BE ±0.25
4. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS
   OTHERWISE NOTED.
5. BACKUP MUST BE Poured MONOLITHICALLY WITH FOOTING
   AND PAD UNLESS EXISTING SURFACE IS APPROVED
   CONCRETE (SEE SHEET 2, NOTE 4).

CONCRETE BACKUP, OG ON GRADE

35-40-08 1 of 2
Concrete Backup on Existing Concrete - Narrow System

Reference DWG 354008, SH. 2

NOTES:
1. 28 MPa (4000 PSI) PORTLAND CEMENT CONCRETE REQUIRED.
2. LINEAR TOLERANCES TO BE ±6 [0.25].
3. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.
4. APPROVED CONCRETE SURFACE IS:
   a. MIN. 150 [6.00] DECK STRUCTURE.
   b. MIN. 200 [8.00] NON-REINFORCED ROADWAY.
   c. MIN. 150 [6.00] REINFORCED ROADWAY.
5. VERTICAL REBAR TO BE INSTALLED USING MP-33® ANCHORING SYSTEM (CUT OUT ON EQUAL, AS DETAILED). IT WOULD REQUIRE QUANTITY 2 PART NO. 3525/100-0000 MP-33®, QUART PACKAGES.

BACKUP ON APPROVED CONCRETE (SEE NOTES 1 & 4)

CONCRETE BACKUP QQG
ON EXISTING CONCRETE STRUCTURE

CONCRETE

REINFORCEMENT DETAIL

Dowel Top View

Dowel Side View

Rebar Detail

Front View

Dowel Rebar Detail

PARTS LIST

SYSTEM MODEL NO. | CONCRETE | REBAR
--- | --- | ---
| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |

| | | |
**Concrete Pad For Concrete Backup - Narrow System**

**Reference DWG 354077**

<table>
<thead>
<tr>
<th>TABLE &quot;L&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NO. OF EAYS</strong></td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
</tbody>
</table>

**SECTION A-A**

**PLAN VIEW**

**NOTES:**
1. CROSS SLOPE OF PLT SHALL NOT EXCEED 3%, AND NOT VARY MORE THAN 2% FROM FRONT TO BACK
2. PAD AND BELOW SPACE BACKUP BLOCK SHOULD BE REIN "ONE MIX & POURED CONCRETE CALL" *
3. DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED.

**CONCRETE PAD FOR CONC. BACKUP.3D**
Tension Strut Backup Assembly - Narrow System
Reference DWG 35-40-03

ASSEMBLY NO 30-40-03
BACKUP ASSY, TS, QG
Diaphragm Assembly - Wide System, SH. 1
Reference DWG 607173

www.highwayguardrail.com  www.energyabsorption.com
Revised November, 2011
All rights in copyright preserved
Nose Assembly - Wide System
Reference DWG 617386

www.highwayguardrail.com
www.energyabsorption.com
Revised November, 2011
All rights in copyright preserved
Fender Panel Assembly - Wide System
Reference DWG 608241
Concrete Backup Assembly - Wide System
Reference DWG 604513

ASSEMBLY NO. 6010/3
BACKUP ASSY, CONCRETE, ____CG WDE
Concrete Pad and Backup - Wide System, SH. 1
Reference DWG 354041-0000

Leaves 2 or 3 for Backup

### TABLE 1

<table>
<thead>
<tr>
<th>NO.</th>
<th>(PPI) LENGTH</th>
<th>(PPI) HANG-ON</th>
<th>CONCRETE DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>b</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.75</td>
<td>15.5</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.5</td>
<td>15.5</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.35</td>
<td>15.5</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.2</td>
<td>15.5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>15.5</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**

1. **Concrete Pad** shall be designed to be 4000 PPI P.C. Concrete.
2. For erosion control, concrete barriers shall be designed to be 150 PPI.
3. The pad and backup shall be designed to be poured monolithically.
4. The pad and backup shall be designed to be poured monolithically.
5. The pad and backup shall be designed to be poured monolithically.

---

**Concrete Pad & Backup, QQ WDE**
Concrete Pad and Backup - Wide System, SH. 2
Reference DWG 3540411-0000

Revised November, 2011
All rights in copyright preserved.

Concrete Pad & Backup, 9G Wide
On Grade.
Concrete Pad and Backup - Wide System, SH 3.
Reference DWG 3540411-0000

www.highwayguardrail.com
www.energyabsorption.com

Revised November, 2011
All rights in copyright preserved

78
Tension Strut Backup Assembly - Wide System
Reference DWG 3540390-0000

ASSEMBLY NO 3540390-0000
BACKUP ASSY, TS, Q3 WIDE

PARTS LIST

<table>
<thead>
<tr>
<th>ITEM</th>
<th>STOCK NO.</th>
<th>DESCRIPTION</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9213000C</td>
<td>BACKUP, TS, Q3 WIDE</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>9113000C</td>
<td>PANEL, TS, Q3 WIDE</td>
<td>2.00</td>
</tr>
<tr>
<td>4</td>
<td>11351200</td>
<td>BOLT M10 X 50, FORM 1, GRADE 8.8</td>
<td>10.0</td>
</tr>
<tr>
<td>5</td>
<td>1135200C</td>
<td>NUT M10, GRADE 8.8</td>
<td>10.0</td>
</tr>
<tr>
<td>7</td>
<td>1135300C</td>
<td>WASHER, 3.5/60</td>
<td>96.0</td>
</tr>
<tr>
<td>9</td>
<td>00340100</td>
<td>ARCHER, 3FT 0.0625, 5/8 X 3/4</td>
<td>3.00</td>
</tr>
<tr>
<td>10</td>
<td>00340100</td>
<td>NUT M5, GRADE 8.8</td>
<td>4.00</td>
</tr>
<tr>
<td>11</td>
<td>00340100</td>
<td>BOLT M5 X 3/4, GRADE 8.8</td>
<td>4.00</td>
</tr>
<tr>
<td>12</td>
<td>1135600C</td>
<td>BOLT M10 X 50, GRADE 8.8</td>
<td>8.00</td>
</tr>
<tr>
<td>13</td>
<td>11351200</td>
<td>BOLT M10 X 50, FORM 1, GRADE 8.8</td>
<td>8.00</td>
</tr>
<tr>
<td>14</td>
<td>1135200C</td>
<td>NUT M10, GRADE 8.8</td>
<td>8.00</td>
</tr>
<tr>
<td>15</td>
<td>0017500C</td>
<td>METAL PLATE, PANEL, Q3</td>
<td>2.00</td>
</tr>
<tr>
<td>16</td>
<td>0017500C</td>
<td>BOLTS SET, Q3</td>
<td>4.00</td>
</tr>
<tr>
<td>17</td>
<td>0017500C</td>
<td>BOLTS SET, Q3</td>
<td>4.00</td>
</tr>
<tr>
<td>18</td>
<td>0017500C</td>
<td>BOLTS SET, Q3</td>
<td>4.00</td>
</tr>
<tr>
<td>19</td>
<td>0017500C</td>
<td>BOLTS SET, Q3</td>
<td>4.00</td>
</tr>
</tbody>
</table>

TABLE A

<table>
<thead>
<tr>
<th>ASSEMBLY NO</th>
<th>STOCK NO.</th>
<th>DESCRIPTION</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>80149965</td>
<td>80149965</td>
<td>BACKUP, TS, Q3 WIDE</td>
<td>1220</td>
</tr>
<tr>
<td>80479801</td>
<td>80479801</td>
<td>BACKUP, TS, Q3 WIDE</td>
<td>2100</td>
</tr>
</tbody>
</table>

NOTES:
- WHEN TRANSITIONING QUADRA GUIDE TO EXISTING BARRIER,
  REFER TO THE TRANSITION ASSEMBLY DRAWINGS FOR PROPER USE
  OF SIDE PANEL, PART NO. 411300C.

ASSEMBLY NO. SEE TABLE A

www.energyabsorption.com
Revised November, 2011
All rights in copyright preserved
Concrete Pad for Tension Strut Backup
Reference DWG 354076, SH. 1

TABLE
<table>
<thead>
<tr>
<th>NO. OF</th>
<th>YARD IN PAD</th>
<th>YARD IN REBAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.74 [5'-9&quot;&quot;]</td>
<td>14.83 [4'-8&quot;&quot;]</td>
</tr>
<tr>
<td>2</td>
<td>2.74 [5'-9&quot;&quot;]</td>
<td>14.83 [4'-8&quot;&quot;]</td>
</tr>
<tr>
<td>3</td>
<td>2.56 [5'-5&quot;&quot;]</td>
<td>12.76 [4'-2&quot;&quot;]</td>
</tr>
<tr>
<td>4</td>
<td>2.47 [5'-2&quot;&quot;]</td>
<td>12.06 [3'-10&quot;&quot;]</td>
</tr>
<tr>
<td>5</td>
<td>6.40 [2'-0&quot;&quot;]</td>
<td>35.12 [11'-6&quot;&quot;]</td>
</tr>
<tr>
<td>6</td>
<td>7.22 [2'-4&quot;&quot;]</td>
<td>40.64 [13'-3&quot;&quot;]</td>
</tr>
<tr>
<td>7</td>
<td>8.23 [2'-7&quot;&quot;]</td>
<td>45.84 [15'-3&quot;&quot;]</td>
</tr>
<tr>
<td>8</td>
<td>9.14 [2'-1&quot;&quot;]</td>
<td>52.23 [17'-2&quot;&quot;]</td>
</tr>
</tbody>
</table>

NOTES:
1. GRAD SLOPE OF PAD SHALL NOT EXCEED 2%, AND NOT VARY MORE THAN 2% FROM FRONT TO BACK
2. UNITS OF MEASUREMENT ARE MILLIMETERS (INCHES) UNLESS OTHERWISE NOTED
Optional 8" Concrete Pad for Tension Strut Backup
Reference DWG 354076, SH. 2