VALTIR

QuadGuard®
CRASH CUSHION
ASSEMBLY MANUAL

PN 115348
REVISION D NOVEMBER 2022

QuadGuard®

The QuadGuard® system has been tested pursuant to National Cooperative Highway Research Program ("NCHRP") Report 350 specifications. The QuadGuard® system has been deemed eligible for federal-aid reimbursement on the National Highway System by the Federal Highway Administration ("FHWA").

Assembly Manual

15601 Dallas Parkway
Suite 525
Addison, Texas 75001

Warning: The local highway authority, distributors, owners, contractors, lessors, and lessees are RESPONSIBLE for the assembly, maintenance, and repair of the QuadGuard®. Failure to fulfill these RESPONSIBILITIES with respect to the assembly, maintenance, and repair of the QuadGuard® could result in serious injury or death.

Important: These instructions are for standard assembly specified by the appropriate highway authority. In the event the specified system assembly, maintenance, or repair would result in a deviation from these assembly instructions, contact the appropriate highway authority engineer.

This manual must be available to the worker overseeing and/or assembling the product at all times. For additional copies, contact Valtir directly at (888) 323-6374 or visit Valtir.com.

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® information available to Valtir at the time of printing. We reserve the right to make changes at any time. Please contact Valtir to confirm that you are referring to the most current instructions.

Part No. 115348

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Customer Service Contacts

Valtir is committed to the highest level of customer service. Feedback regarding the QuadGuard®, its assembly procedures, supporting documentation, and performance is always welcome. Additional information can be obtained from the contact information below:

Valtir

Telephone:	(888) 323-6374 (USA) (312) 467-6750 (International)
E-mail:	Valtir.com/Contact
Internet:	Valtir.com

Important Introductory Notes

Proper assembly of the QuadGuard® system is critical to achieve performance that has been evaluated and deemed eligible by the FHWA per NCHRP Report 350. These instructions should be read in their entirety and understood before assembling the QuadGuard®. These instructions are to be used in conjunction with the assembly of QuadGuard® and are for standard assemblies only as specified by the applicable highway authority. If you need additional information, or have questions about the QuadGuard®, please contact the highway authority that has planned and specified this assembly and, if needed, contact Valtir Customer Service. This product must be assembled in the location specified by the appropriate highway authority. If there are deviations, alterations, or departures from the assembly instructions specified in this manual, the device may not perform as tested.

Important: **DO NOT** use any component part that has not been specifically specified herein for the QuadGuard® during assembly or repair.

This product has been specified for use by the appropriate highway authority and has been provided to that user who has unique knowledge of how this system is to be assembled. No person should be permitted to assist in the assembly, maintenance, or repair of this system that does not possess the unique knowledge described herein. These instructions are intended for an individual qualified to both read and accurately interpret them as written. These instructions are intended only for an individual experienced and skilled in the assembly of highway products that are specified and selected by the highway authority.

A manufacturer's drawing package will be supplied by Valtir upon request. Each system will be supplied with a specific drawing package unique to that system. Such drawings take precedence over information in this manual and shall be studied thoroughly by a qualified individual who is skilled in interpreting them before the start of any product assembly.

Safety Symbols

This section describes the safety symbols that appear in this QuadGuard® manual. Read the manual for complete safety and assembly information.

Symbol	Meaning
	**Safety Alert Symbol:** Indicates Important, Caution, Warning, or Danger. Failure to read and follow the Important, Caution, Warning, or Danger indicators could result in serious injury or death to the workers and/or bystanders.
	**Warning:** Read safety instructions thoroughly and follow the assembly directions and suggested safe practices before assembling, maintaining, or repairing the QuadGuard®. It is the responsibility of the installer to follow the instruction contained in this manual. Failure to comply with these warnings could result in increased risk of serious injury or death in the event of a vehicle impact with a system.
	**Important:** Please keep up-to-date instructions for later use and reference by anyone involved in the assembly of the product.

Safety Rules for Assembly

*** Important Safety Instructions ***

This manual must be kept in a location where it is readily available to persons who are skilled and experienced in the assembly, maintenance, or repair of the QuadGuard®. Additional copies of this manual are available from Valtir by calling (888) 323-6374, or by visiting Valtir.com/Contact. Please contact Valtir if you have any questions concerning the information in this manual or the QuadGuard®.

It is the responsibility of the installer to use appropriate safety precautions when operating power equipment, mixing chemicals, and when moving heavy equipment or QuadGuard® components. Safety articles including but not necessarily limited to work gloves, eye protection, safety-toe shoes, and back protection should be used.

Warning: It is the responsibility of the installer to use all safety measures incorporating appropriate traffic control devices specified by the highway authority. These measures must be used to protect all personnel while at the assembly, maintenance, or repair site.

Warning: Failure to comply with these warnings could result in increased risk of serious injury or death in the event of a vehicle impact with a system that has not been accepted by the FHWA.

Warning: Use only Valtir parts on the QuadGuard® for assembly, maintenance, or repair. The use of component parts not specified herein is **strictly prohibited**. The QuadGuard® assembled with Valtir Parts has been tested, approved, and accepted for state use by the FHWA. A QuadGuard® using parts other than those specified herein has not been tested, approved, or accepted for state use by the FHWA. Failure to follow this warning could result in increased risk of serious injury or death in the event of a vehicle impact.

Limitations and Warnings

Valtir contracts with FHWA approved testing facilities to perform crash tests, evaluate test results, and submit results to the FHWA for review.

The QuadGuard® system has been deemed eligible for reimbursement by FHWA as meeting the requirements and guidelines of NCHRP Report 350. NCHRP Report 350 tests are designed to evaluate product performance involving a range of vehicles on roadways, from lightweight cars (approx. 1800 lb. [820 kg]) to full size pickup trucks (approx. 4400 lb. [2000 kg]). A product can be certified for multiple Test Levels. The QuadGuard® system is certified to the Test Level(s) as shown below:

Test Level 2: 43 mph [70 kph]

Test Level 3: 62 mph [100 kph]

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 Report 350 as approved by FHWA.

Valtir 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 in consultation with Valtir or by third parties.

The QuadGuard® is intended to be assembled, delineated, and maintained within specific state and federal guidelines. It is important for the highway authority specifying the use of a highway product to select the most appropriate product configuration for its site specifications. The customer should be careful to properly select, assemble, and maintain the product. Site lay out, vehicle population type; speed, traffic direction, and visibility are important elements that require evaluation in the selection of a highway product. For example, curbs could cause an untested effect on an impacting vehicle.

After an impact occurs, the debris from the impact should be removed from the area immediately and the specified highway product should be evaluated and restored to its original specified condition or replaced as the highway authority determines as soon as possible.

Important: It is the sole responsibility of the project engineer and/or the local highway authority and its engineers to determine whether use or reuse of any part of the system is appropriate or acceptable following an impact. Valtir makes no recommendation or suggestion regarding this determination. Each impact is unique.

System Overview

The QuadGuard® is a potentially reusable, re-directive, non-gating crash cushion for roadside obstacles ranging in width from 24” to 126” (610 mm to 3200 mm). It consists of energy-absorbing cartridges surrounded by a framework of Quad-Beam Panels.

Important: Valtir makes no recommendation whether use or reuse of any part of the system is appropriate or acceptable following an impact. It is the sole responsibility of the project engineer and/or the local highway authority and its engineers to make that determination. It is critical that you inspect this product after assembly is complete to make certain that the instructions provided in this manual have been strictly followed.

The QuadGuard® utilizes two types of cartridges in a staged configuration designed 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 and appropriate number of Bays for a site (p. 39).

Impact Performance

The 6 Bay QuadGuard® 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 62 mph [100 km/h] at angles up to 20 degrees.

During head-on impact testing, within NCHRP Report 350 criteria, the QuadGuard® is designed to telescope rearward to absorb the energy of impact. When impacted from the side, within the applicable NCHRP Report 350 criteria, it is designed to redirect the vehicle back toward its original travel path and away from the roadside obstacle.

Warning: Do NOT modify the QuadGuard® in any way.

Warning: Ensure that the QuadGuard® system and delineation used meet all federal, state, specifying agency, appropriate Manual on Uniform Traffic Control Devices (“MUTCD”), and local specifications.

Warning: It is the responsibility of the installer to ensure that your assembly procedure meets all appropriate Occupational Safety and Health Administration (“OSHA”) and local standards.

Inspect Shipping

Before deploying the QuadGuard®, check the received parts against the shipping list supplied with the system. Make sure all parts have been received.

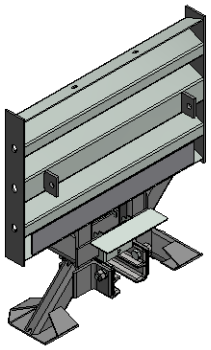
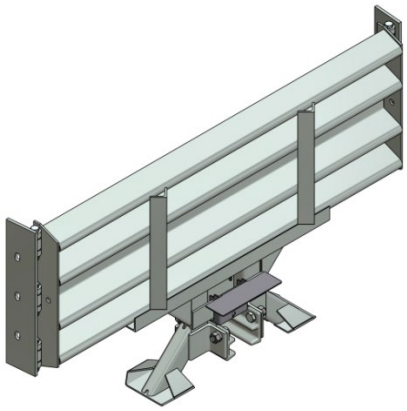
Important: The Manufacturer’s Drawing Package supplied with the QuadGuard® must be used with these instructions for proper assembly and should take precedence over these general instructions.

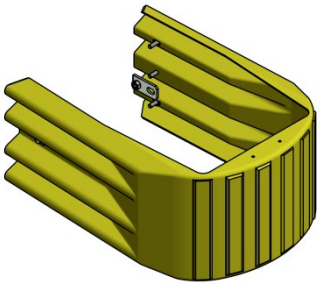
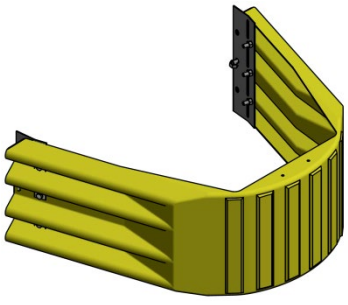
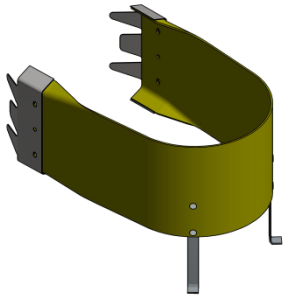
System Components

Below is a list of system components to be used in the repair of your particular QuadGuard® configuration. Please call Valtir customer support if you have any system questions (p. 3).

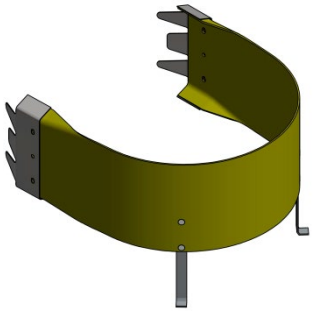
Warning: Use only Valtir parts that are specified herein for the QuadGuard® for assembling, maintaining, or repairing the QuadGuard®. **Do not utilize or otherwise comingle parts from other systems even if those systems are other Valtir systems.** Such configurations have not been tested, nor have they been deemed eligible for use. Assembly, maintenance, or repairs using unspecified parts or accessories is strictly prohibited.

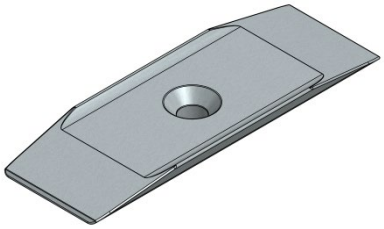
Note: Components are not shown to scale.

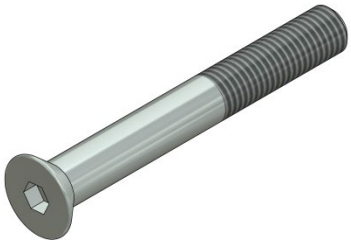
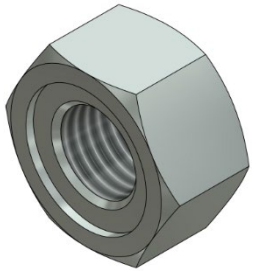
Narrow Diaphragm Assemblies *	Wide Diaphragm Assemblies *		
			
625650 - 24” 625651 - 30” 625652 - 36” 606810 - 48”	607173 - 26.48” 607174 – 29.65” 607175 – 32.78” 607176 – 35.93” 607177 – 39.08” 607145 – 42.23” 607146 – 45.38”	607148 – 48.53” 607149 – 50.11” 607150 – 51.68” 607151 – 54.83” 607152 – 57.98” 607156 – 59.56”	607157 – 61.13” 607158 – 64.28” 607159 – 68.06” 607160 – 70.58” 607162 – 73.73” 607163 – 76.88” 607164 – 80.04”

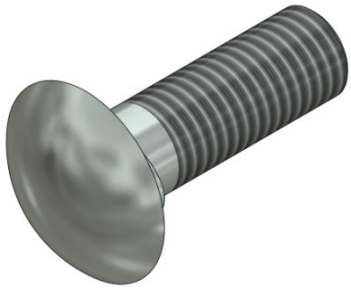
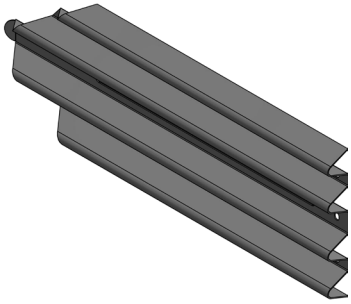
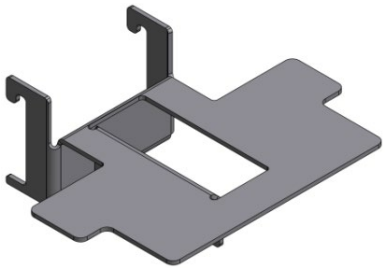
Nose, Narrow Plastic *	Nose, Wide Plastic *	Nose, Narrow Belt *
		
611547 - Yellow 611542 - Gray	611647 - Grey 611648 – Yellow	611538 – Grey 611539 – Yellow

***Parts in red are included in assemblies.**

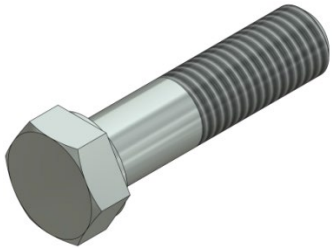
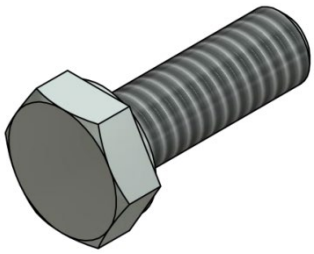
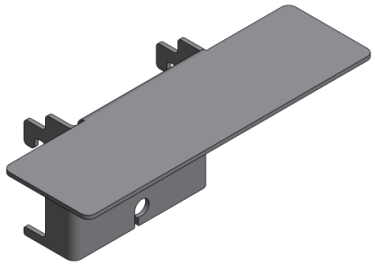
Nose, Wide Belt *	Cartridge Type I	Cartridge Type II
		
611541 - Yellow 611540 - Grey	606027	606029

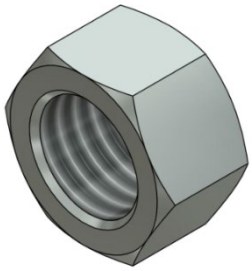
Mushroom Washer	Flat Screw 5/8X8 1/2" Wide	Die Spring, 6”, Wide
		
617045	116879	117458

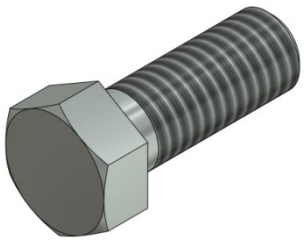
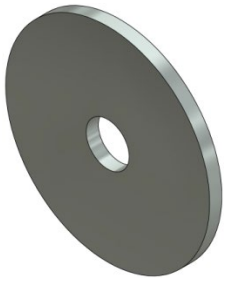
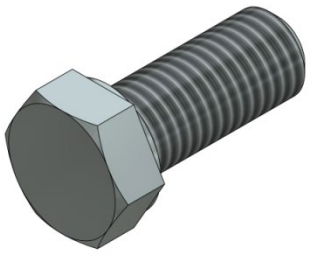
Flat Screw 5/8X5”,G8, Narrow	Die Spring, 1 1/2”, Narrow	Rail Nut, Hex, 5/8”
		
116878	117458	003340

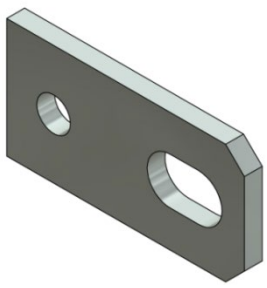
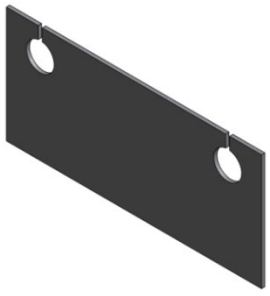
Rail Bolt, 5/8X2”	Panel, Fender Assembly, QG	Bracket, Cart, Nose
		
003400	608236	605420

***Parts in red are included in assemblies.**

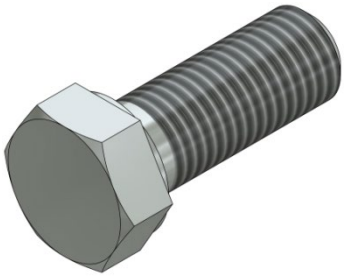
Bolt, Hex, 5/8” X 2 1/2", G5	Bolt, Hex, 1/4" X 3/4", G5	Bracket, Cartridge Support
		
118232	113518	605446

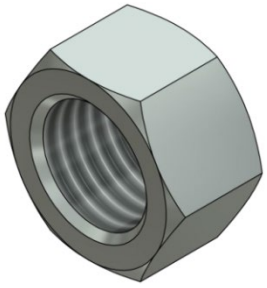
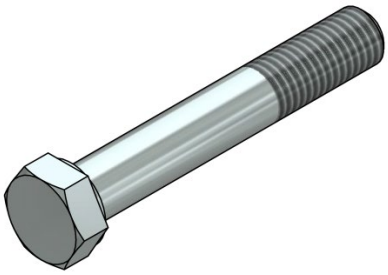
Washer, Lock, 5/8”	Washer, Flat 3/8” X 1”	Nut, Hex, 3/8” X 1”
		
118100	118036	115960

Bolt, Hex, 3/8” X 1”,G5	Washer, Fender, 3/8” X 2”	Bolt, Hex, 5/8”X 1 1/2", G5
		
113596	118038	113654

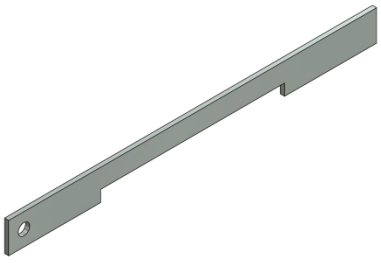
Bracket, Pull-Out	Shim Kit, 1/8” X 3 5/8” X 8”(2)	Washer, Lock, 3/4"
		
605535	614050	118089

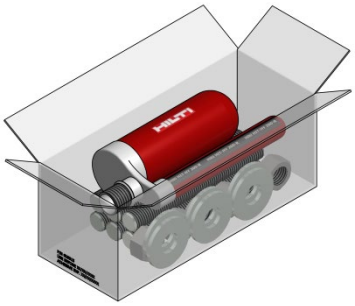
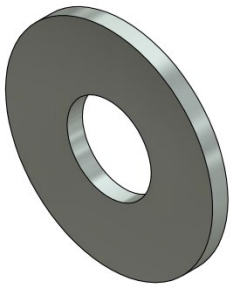
***Parts in red are included in assemblies.**

Bolt, Hex, 3/4" X 2”, G8	Monorail Guide	Nut, Heavy Hex, 3/4"
		
113555	611368	003704

Nut, Heavy Hex, 5/8”	Hinge Plate, Fender Panel	Bolt, Hex, 5/8” X 4”, G5
		
003354	610172	113666

***Parts in red are included in assemblies.**

Panel, Side, QG	Bracket, Cartridge Support TS B/U	Locking Bar, Cartridge Support
		
611898	605447	611266

Approved Adhesive *	Stud, 7”, G5	Washer, Flat, 3/4"
		
619316	117542	118027

*See Valtir Approved Adhesive Anchoring System section on page 12.

Foundation/Anchoring

Warning: It is the responsibility of the local DOT or appropriate highway authority to ensure the assembly conforms to the AASHTO Roadside Design Guide.

Asphalt Installations

QuadGuard® Narrow systems with a Tension-Strut Backup may be temporarily installed in construction zones on asphalt. Assemblies on Asphalt Concrete **("A.C.")** must provide a minimum of 76 mm [3"] layer of asphalt over a minimum of 76 mm [3"] layer of **Portland Cement Concrete ("P.C.C.")**, 152 mm [6"] layer of asphalt over 152 mm [6"] layer of subbase, or 203 mm [8"] layer of asphalt with no subbase.

Important: Only 460 mm [18"] threaded rods, utilizing Valtir approved adhesive, can be used with asphalt foundations. Contact Customer Service for a complete list of approved adhesives (p. 3).

Concrete Installations

For concrete installations, the QuadGuard® 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 project engineer or appropriate highway authority.

The QuadGuard® 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 P.C.C.

Anchorage: Approved adhesive with 180 mm [7"] studs 140 mm [5 1/2"] embedment

Foundation B: Asphalt over P.C.C.

Foundation: 76 mm [3"] minimum A.C. over 76 mm [3"] minimum P.C.C.

Anchorage: Length of anchor required is 460 mm [18"] 420 mm [16 1/2"] embedment

Foundation C: Asphalt over Compacted Subbase ("C.S.")

Foundation: 150 mm [6"] minimum A.C. over 150 mm [6"] minimum **C.S.**

Anchorage: Approved adhesive with 460 mm [18"] studs 420 mm [16 1/2"] embedment

Foundation D: Asphalt Only

Foundation: 200 mm [8"] minimum A.C.

Anchorage: Approved adhesive with 460 mm [18"] studs - 420 mm [16 1/2"] embedment

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 six months. See Post Impact Instructions and Maintenance and Repair instructions on page 59 and 60.

Valtir Approved Adhesive Anchoring System

A Valtir approved adhesive anchoring system is required to securely anchor crash cushions. Each approved adhesive kit contains adhesive, studs, nuts, washers and instructions. Both vertical and horizontal assemblies are possible using an approved adhesive anchoring system.

Vertical Assemblies

Note: Read all Valtir approved adhesive instructions before starting.

1) **Prepare the Concrete Foundation**

Warning: Do not allow anchoring adhesive to contact skin or eyes. See material safety data sheet supplied with adhesive kit for first-aid procedures. Use only in well-ventilated area. Do not use near open flame.

Warning: Wear gloves and protective eyewear during application.

The anchor bolts (studs) that anchor the QuadGuard® Backup and/or Monorail sections to the concrete foundation must be those shipped in the kit or of high strength steel (Grade B7 or SAE-J429 Grade 5). These studs must be set in minimum 4000 psi [28 MPa] concrete. Allow the concrete to cure a minimum of seven days before applying anchoring adhesive.

2) Drill Boreholes

Caution: It is the responsibility of the installer to consult OSHA silica respiratory standard 29 CFR 1910.134 for debris removal from borehole(s) and use Valtir approved adhesive to achieve optimum tensile strength. Do not use diamond drill bits for drilling boreholes.

Use the Monorail(s) and Tension Strut Backup as drilling templates. Use a rotary hammer drill to drill the boreholes 7/8” [22 mm] diameter to the recommended depth. See the approved adhesive instructions provided with adhesive kit. Check to ensure each borehole is drilled to the proper depth and aligned with the part to be anchored per table below.

Anchoring Information					
Stud Size:	**Orientation**	**Bit Size**	**Minimum Depth**	**Torque**	**Medium**
3/4”x 6 1/2"	Horizontal	7/8” [22 mm]	5 1/4” [133 mm]	Manufacturer Spec	Concrete
3/4”x 7"	Vertical	7/8” [22 mm]	5 3/4” [145 mm]	Manufacturer Spec	Concrete
3/4”x 18"	Vertical	7/8” [22 mm]	16 3/4” [425 mm]	10 ft-lb [15 N-m]	Asphalt

Important: When mounting on asphalt, initial torque shall be as shown in the Anchoring Information table above. Due to the properties of asphalt, anchors may loosen over time. For this reason Valtir recommends anchoring to asphalt only at temporary locations. It is recommended to re-torque anchors in asphalt every six (6) months to the proper initial torque specified.

3) Clean the Boreholes

Blow the concrete dust from the borehole using oil-free compressed air. Thoroughly brush it with a 7/8" diameter steel bristle tube brush and then blow it out again. If the borehole is wet, completely flush it with water while brushing and then blow it clean to remove all water using oil-free compressed air.

Note: Use of the Valtir approved vacuum drilling equipment is authorized to replace the blowing and brushing requirement of Step 3.

4) Apply Approved Adhesive

Fill the borehole 100% full.

Caution: Fill borehole 100% full so it is even with the pavement surface per manufacturer's instructions.

5) Add the Washers and Nuts

Place a flat washer onto the stud then thread a nut on until the end of the stud is flush with the NUT (Figure 1).

6) Insert Studs in Boreholes and Wait for Adhesive to Cure

Push the stud, nut, and washer assembly down through the part and into the borehole until the washer is seated against the part.

Caution: Do not disturb or load the stud until the approved adhesive material has hardened per manufacturer specifications.

7) Torque the Nuts

Once the adhesive has fully cured, torque the nut to the manufacturer's recommended specifications.

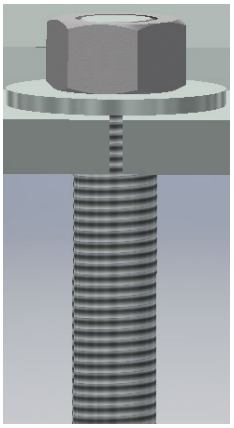


Figure 1
Vertical Application
(Before Applied Torque)

Assembly Cautions

1) Steel rebar

If steel rebar is encountered while drilling an anchor bolt borehole, apply one of the following solutions:

A) Use a rebar drill bit for the **rebar only** and then switch back to the concrete bit to finish drilling into the underlying concrete until the proper borehole depth is reached.

Caution: Do not drill through rebar without first obtaining permission to do so from the project engineer.

B) Drill a new borehole down at an angle past the rebar to the proper depth. Anchor the stud by completely filling both boreholes with an approved adhesive.

Horizontal Assemblies

The horizontal approved adhesive kit is the same as the vertical kit.

Caution: Fill borehole 100% full so it is even with the vertical concrete surface per manufacturer's instructions.

1) **Follow the instructions supplied with your approved adhesive kit**

   Apply approved adhesive to each anchor per instructions.

2) **Add the Washers and Nuts**

   Put washer and nut on stud so the **nut is flush with end of stud**.

3) **Insert each Stud with Washer and Nut into Borehole**

   Push stud through part to be anchored and into borehole. Twist the stud in the approved adhesive to wet the threads.

Important: The stud should be flush with the top of the nut in both **vertical** and **horizontal** applications prior to tightening (Figure 2).

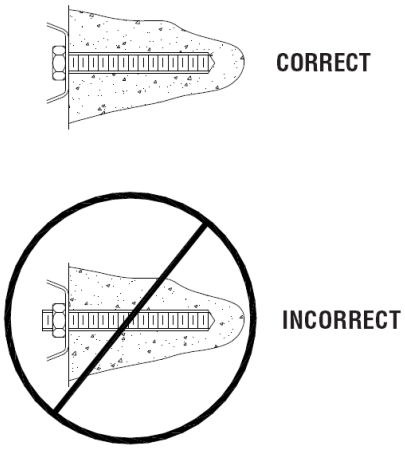


Figure 2
Horizontal Application
(Before Applied Torque)

Caution: Do not disturb or load the stud until the approved adhesive material has hardened (reference approved adhesive kit instructions for hardening times)**.**

4) **Torque the nuts**

   Once the adhesive has fully cured, torque nut(s) to the approved adhesive manufacturing specification.

Recommended Tools

Documentation

- Manufacturer's Assembly Manual
- Manufacturer's Drawing Package

Personal Protective Equipment

- Eye Protection
- Gloves
- Safety Toe Shoes
- Protective Clothing

Cutting Equipment

- Rotary Hammer Drill
- Rebar Cutting Bit
- Concrete Drill Bits – 22 mm [7/8"] **(Double-Fluted**)
- Grinder, Hacksaw or Torch (optional)
- Drill Bits 1/16" through 7/8"

Important: Valtir recommends using double-fluted drill bits to achieve optimum tensile strength when applying an approved adhesive to the anchoring system (p.12).

Hammers

- Sledgehammer
- Standard hammer

Wrenches

- Heavy Duty 1/2" drive impact wrench
- 1/2" drive Sockets: 9/16", 11/16", 3/4", 15/16", 1 1/8", 1 1/4"
- 1/2" drive Deep Well Sockets: 15/16", 1 1/4"
- 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"

Important: Because every impact is different, Valtir makes no recommendation whether use or reuse of any part of the system is appropriate or acceptable following an impact. It is the sole responsibility of the project engineer and/or the local highway authority and its engineers to make that determination. It is critical that you inspect this product after assembly is complete to make certain that the instructions provided in this manual have been strictly followed.

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.
- Air Compressor (100 psi minimum) and Generator (5 kW)
- Long Pry Bar
- Drift Pin 12” [300 mm]
- Center Punch
- Tape Measure 25’ [7.5 m]
- Chalk Line
- Concrete Marking Pencil
- Steel bristled tube brush for cleaning 7/8” drilled boreholes
- Rags, water, and solvent for touch-up

Note: The above list of tools is a general recommendation and should not be considered an exhaustive list. Depending on specific site conditions and the complexity of the assembly specified by the appropriate highway authority the required tools may vary. Decisions as to what tools are needed to perform the assembly properly are the responsibility of the specifying highway authority and the authority’s selected contractor performing the assembly of the system at the authority’s specified assembly site.

How to Determine Left/Right

To determine left from right when ordering parts, stand in front of the system facing the roadside obstacle. Your left is the system’s left and your right is the system’s right.

System Bay Count

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 (Figure 3). The Five-Bay system is shown.

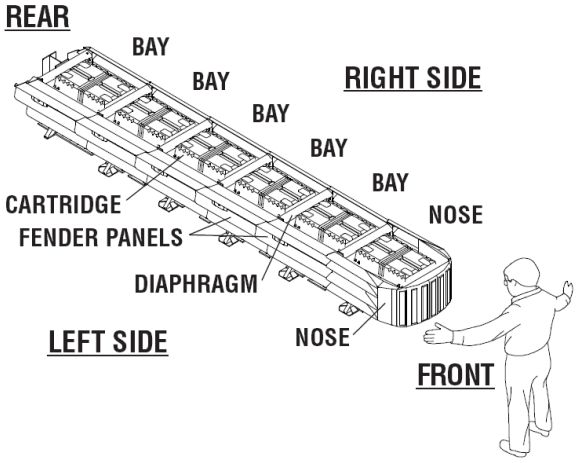


Figure 3 - Orientation

Measuring the Width

The QuadGuard® is available in five nominal widths:

- 24” [610 mm]
- 30” [760 mm]
- 36” [915 mm]
- 48” [1219 mm]
- 69” [1755 mm]
- 90” [2285 mm]
- 126” [3200 mm]

The nominal width of a parallel system is the width of the diaphragm (Figure 4).

The nominal width of a wide system is the width at the location shown in Figure 5.

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

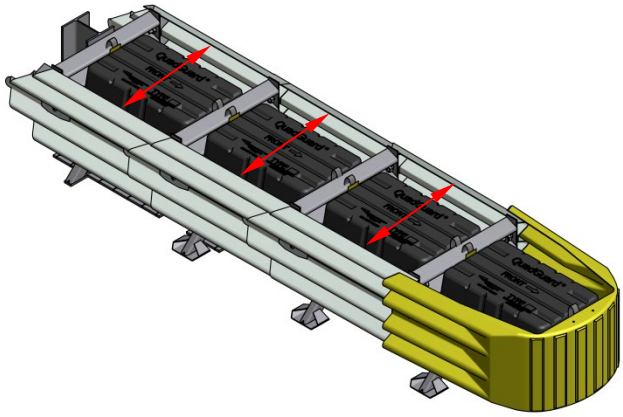


Figure 4
Parallel system

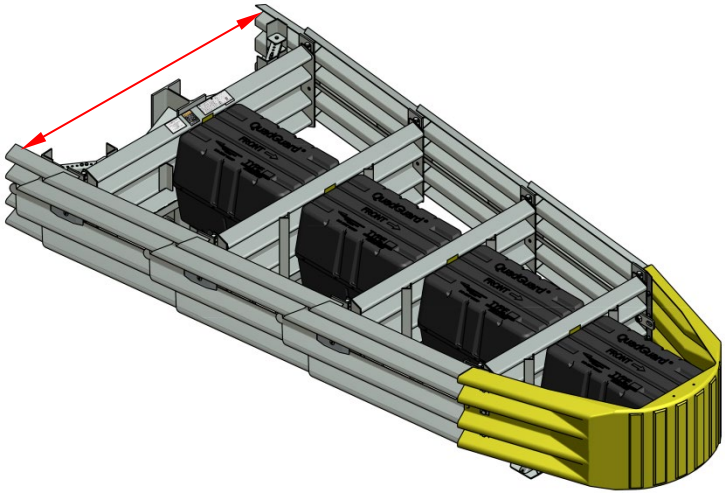


Figure 5
Wide system

Site Preparation/Foundation

A QuadGuard® should be assembled only on an existing or freshly placed and cured concrete base (4000 psi [28 MPa] 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 foundations are provided in Valtir concrete foundation drawings, supplied with the system. The system may be assembled on a non-reinforced concrete roadway (minimum 8" [200 mm] thick). Deployment cross-slope shall not exceed 8% and should not twist more than 2% over the length of the system; the foundation surface shall have a light broom finish.

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

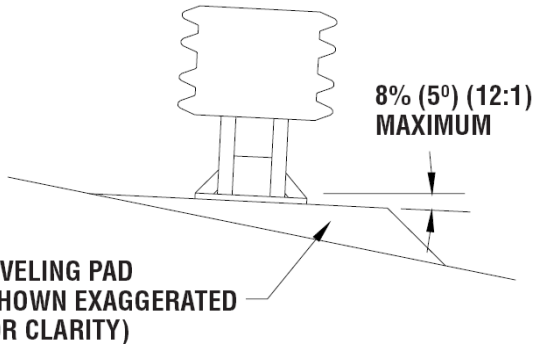


Figure 6
Cross-Slope

Warning: Location of the Backup in relation to nearby objects will affect the operation of the attenuator. Upon impact, the Fender Panels telescope rearward and extend beyond the rigid Backup as much as 30" [760 mm]. Position the Backup so that the rear ends of the last Fender Panels are a minimum of 30" [760 mm] forward of objects that would otherwise interfere with movement of the rearmost Fender Panels. Failure to comply with this requirement will result in impaired system performance offering motorists less protection and component damage.

Narrow System Identification

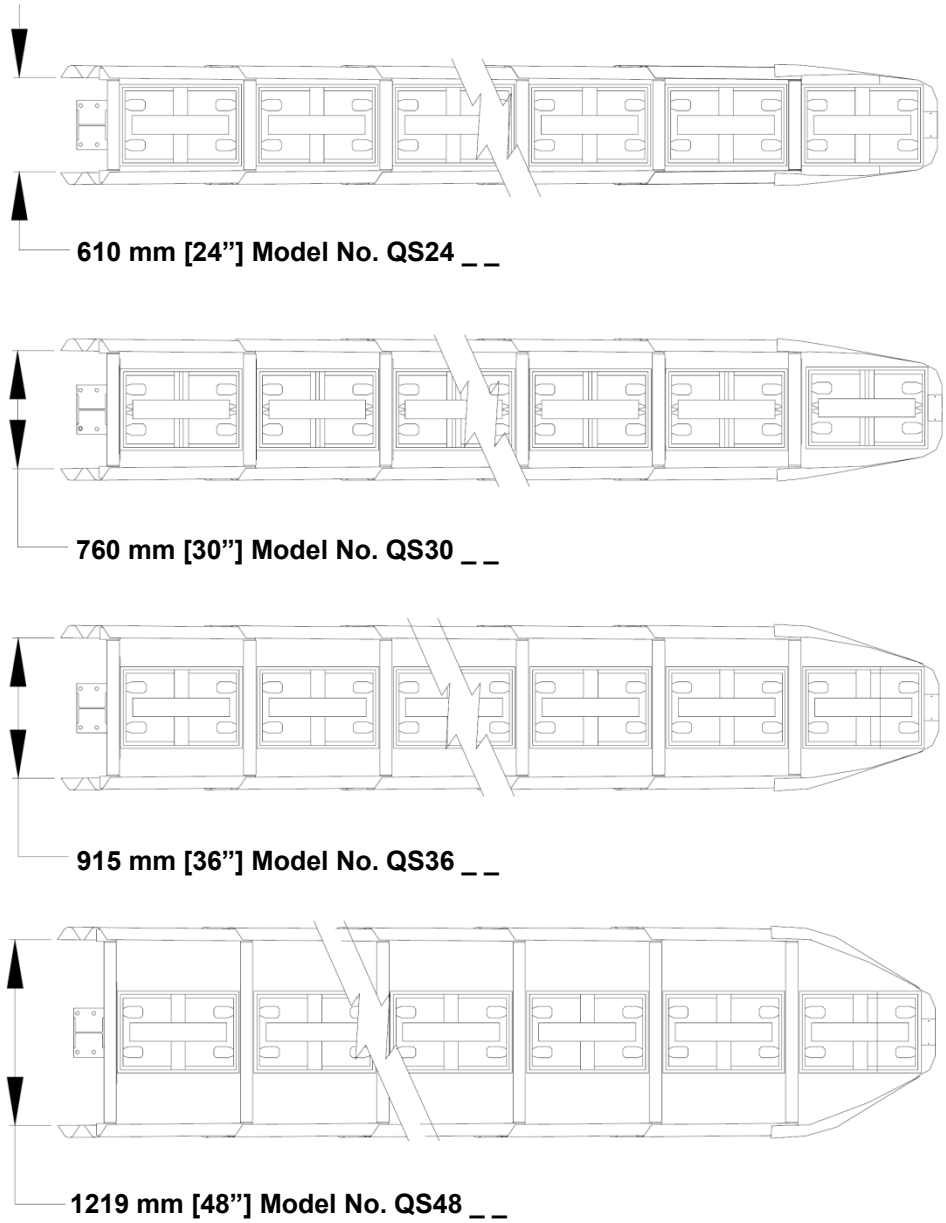


Figure 7
Narrow System(s) and Model Numbers

Inspect Shipping

Check all received parts against the shipping list supplied before QuadGuard® deployment. Make sure all parts have been received.

Important: The Manufacturer's Drawing Package supplied with the QuadGuard® must be used with these instructions for proper assembly and should take precedence over these general instructions.

Determine Backup and Transition Type

The QuadGuard® is available with a Tension Strut Backup or a Concrete Backup. See Figure(s) 8 and 9, along with the Backup Assembly drawing, to determine which type of Backup is being deployed.

A Transition Panel or Side Panel must 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®. See Figures 10 - 14 and the Drawing Package to determine which type of Panels to attach.

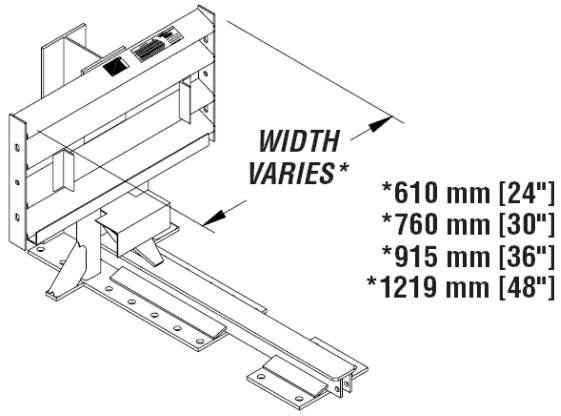


Figure 8
Tension Strut Backup

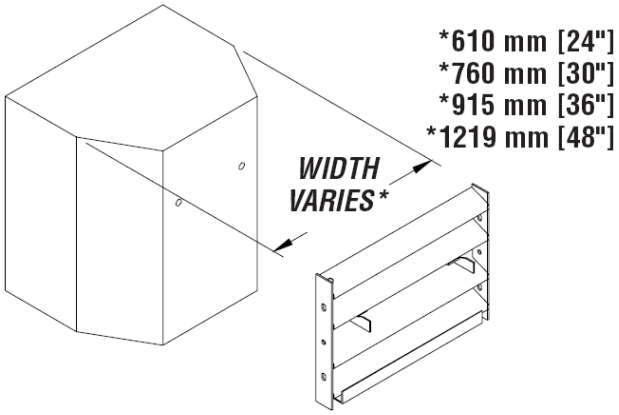


Figure 9
Concrete Backup

Narrow Transitions

Note: The proper Transition Panel or Side Panel must be used for impact performance of the system. The correct Panel(s) to use will depend on the direction of traffic and what type of barrier or roadside obstacle the QuadGuard® is shielding. Contact the Customer Service Department prior to deployment if you have any questions (p. 3).

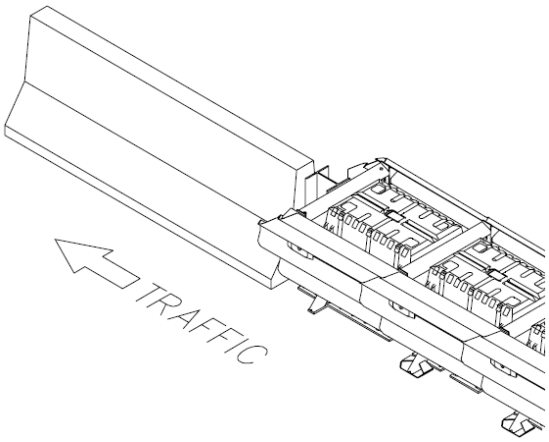


Figure 10
No Transition

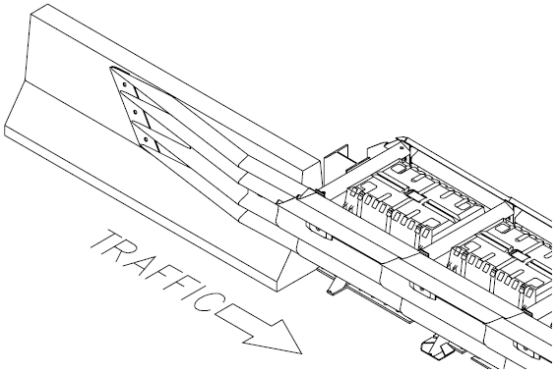


Figure 11
Quad-Beam™ to Safety Shape Barrier

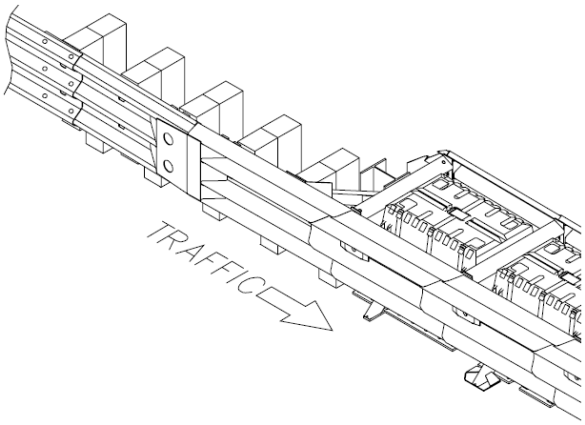


Figure 12
Quad-Beam™ to Thrie-Beam

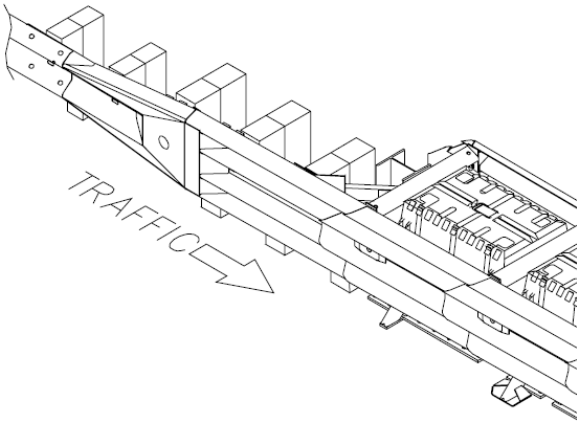


Figure 13
Quad-Beam™ to W-Beam

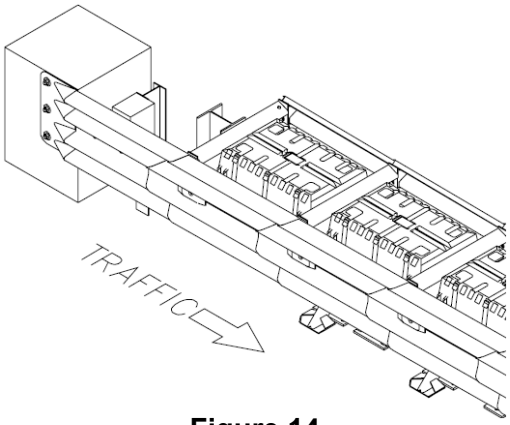


Figure 14
Quad-Beam™ End Shoe

Assembly Narrow

1) Mark System Location

Locate the centerline of the system by measuring the proper offset from the roadside obstacle. See the Drawing Package supplied with the system. Place chalk line to mark the centerline of the system. Mark a construction line parallel to the center line and offset 6.5" [165 mm] to one side as shown in Figure 15. The edge of the Monorail will be positioned on this line.

Note: The concrete foundation must comply with the project plans supplied with the system.

Warning: Location of system with respect to the roadside obstacle is critical and dependent on the type of Transition Panel used. Please refer to the Drawing Package supplied with the system for details.

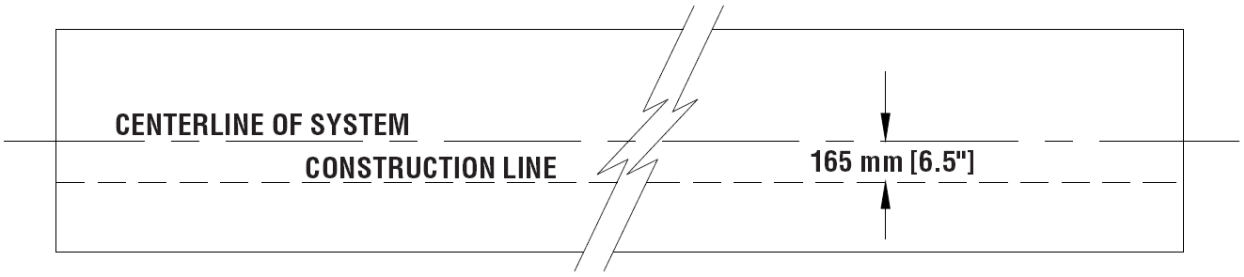


Figure 15
(Top view of concrete foundation)

2) Anchor the Backup

A) Concrete Backup Construction (Figure 16)

Locate Backup Face Plate using the Backup Assembly drawing. Verify that any applicable Transition Panels fit properly before anchoring the Face Plate. Drill anchor holes in the Concrete Backup using the Face Plate as a template. Anchor the Face Plate to the Concrete Backup using the approved adhesive kit supplied with the system (p. 12).

Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

B) Tension Strut Backup Assembly (Figure 17)

Locate Tension Strut Backup and Monorail on foundation with side of Monorail on the construction line (p. 26). Verify that any applicable Transition Panels fit properly before anchoring Backup. Drill anchor holes in foundation using the Backup as template. Anchor the Backup to the concrete foundation using an approved anchoring system (p. 12).

Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

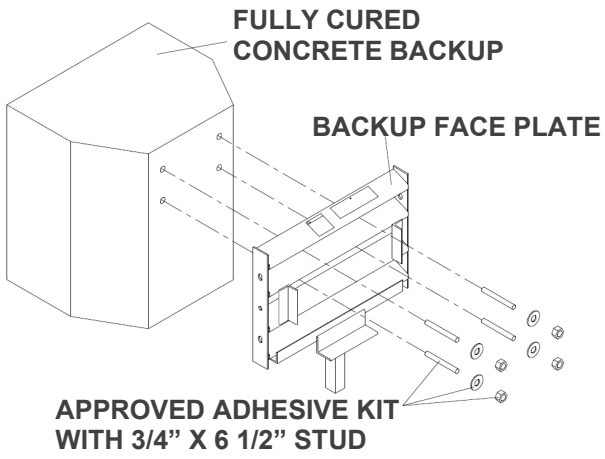


Figure 16
Anchoring Backup Face Plate to Concrete Backup

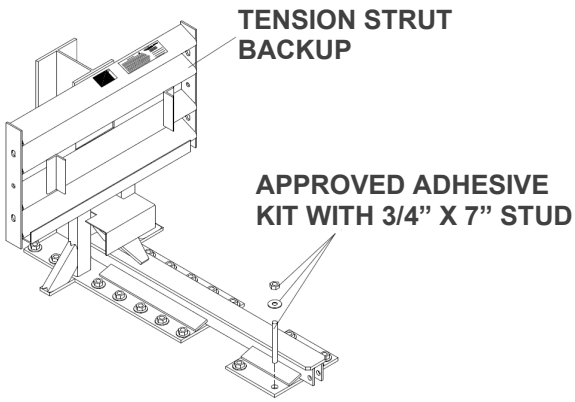


Figure 17
Anchoring Tension Strut Backup to Foundation

Warning: Improper alignment at the Monorail Sections will prevent proper system collapse during impact.

Monorail Alignment

It is important to align each segment of Monorail from the back to the front of the system (±1/4” [6 mm]). Anchor each Monorail section using the provided Valtir approved adhesive kit. See Figures 18 - 21 and the approved adhesive instructions included with the adhesive kit (p. 12).

Drill 0.78” [20 mm] diameter by 5 3/4” [145 mm] boreholes using the Monorail as a template. Do not drill through foundation.

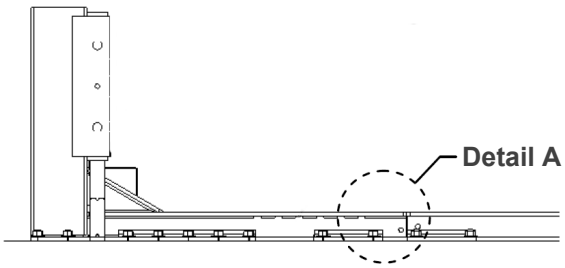
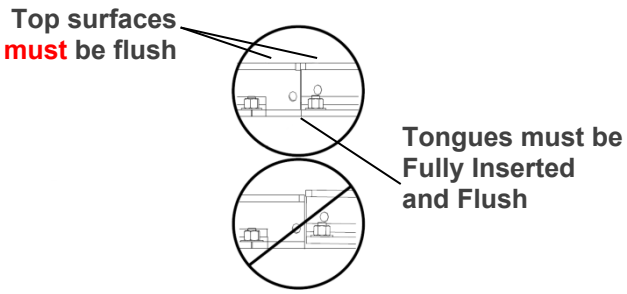


Figure 18
Rail Height and Alignment



Detail A

3) Anchor the Monorail

A) Monorail Assembly for Concrete Backup (Figure 19)

Locate Monorail on foundation with side of Monorail on the construction line and rear edge of Monorail foot 10” forward of front face of Concrete Backup.

Orient the Monorail so that the Monorail tongues face Backup.

Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

Anchor each Monorail section using the approved adhesive kits provided. Reference the adhesive manufacturer’s instructions included with kit. It is important to attach each segment of Monorail in alignment from the back to the front of the system (±1/4” [6 mm]).

Warning: Improper alignment at the Monorail splice joints will prevent proper system collapse during impact (p. 26).

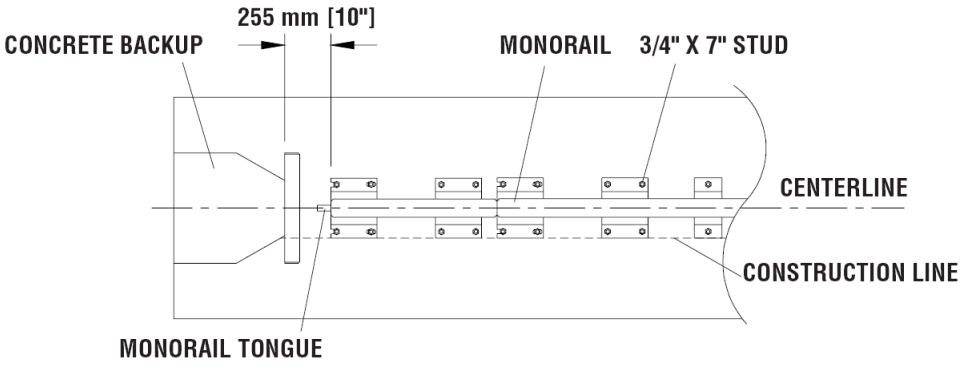


Figure 19
Monorail Location for Concrete Backup

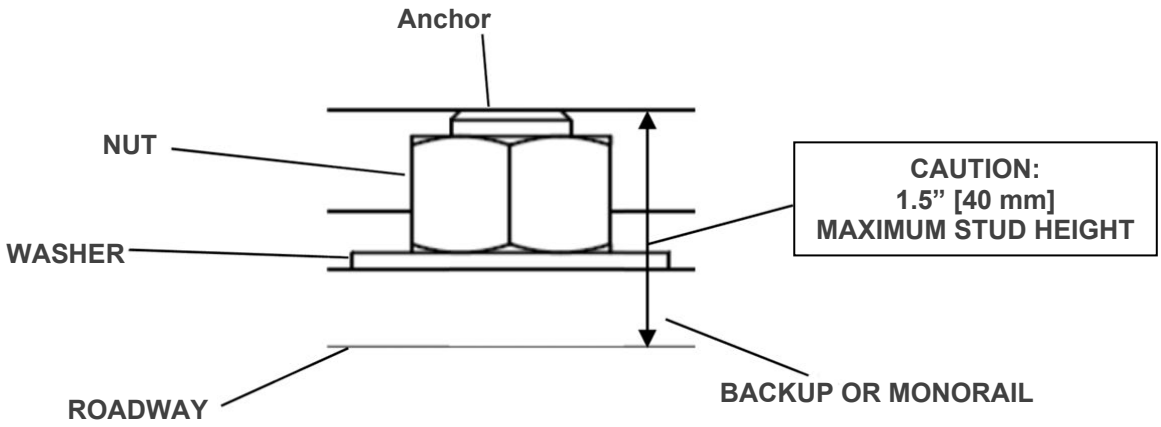


Figure 20
Proper Stud Height

B) Monorail Assembly for Tension Strut Backup (Figure 21)

Locate Monorail on foundation with side of Monorail on the construction line and rear edge of Backup foot 4” forward of edge of foundation (Figure 21).

Drill 5 1/2” [140 mm] deep anchor holes using the Monorail as a template. Do not drill through foundation.

Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

Anchor each Monorail section using the approved adhesive kits provided. Reference the adhesive manufacturer’s instructions included with kit. It is important to attach each segment of Monorail in alignment from the back to the front of the system (±1/4” [6 mm]).

Warning: Improper alignment at the Monorail splice joints will prevent proper system collapse during impact (p. 26).

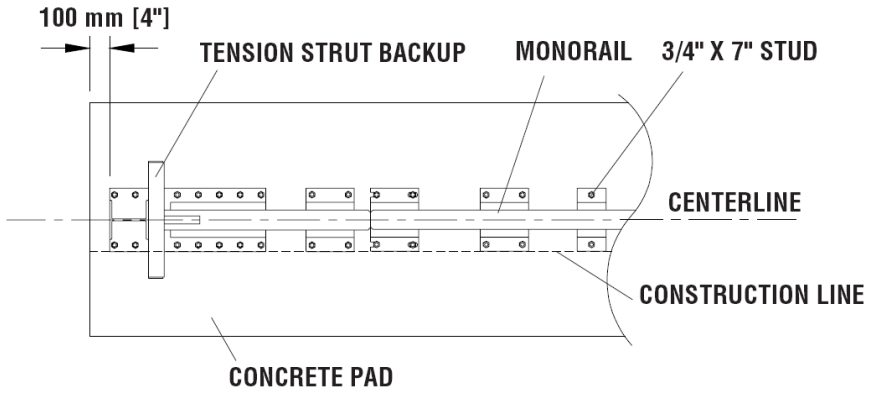


Figure 21
Backup and Monorail Location for Tension Strut Backup

5) Attach Side Panels and/or Transition Panels to Backup Assembly

Attach Transition Panel or Side Panel to side of Backup using 5/8” rail bolt and 5/8” rail nut (two places - top and bottom holes only). See Figure 22 and Backup Assembly drawing.

Note: A Side Panel is not needed when a Transition Panel is used.

Assembly tip:

Use drift pin to align the center hole of the Panel with the center hole of the Backup before inserting the rail bolts.

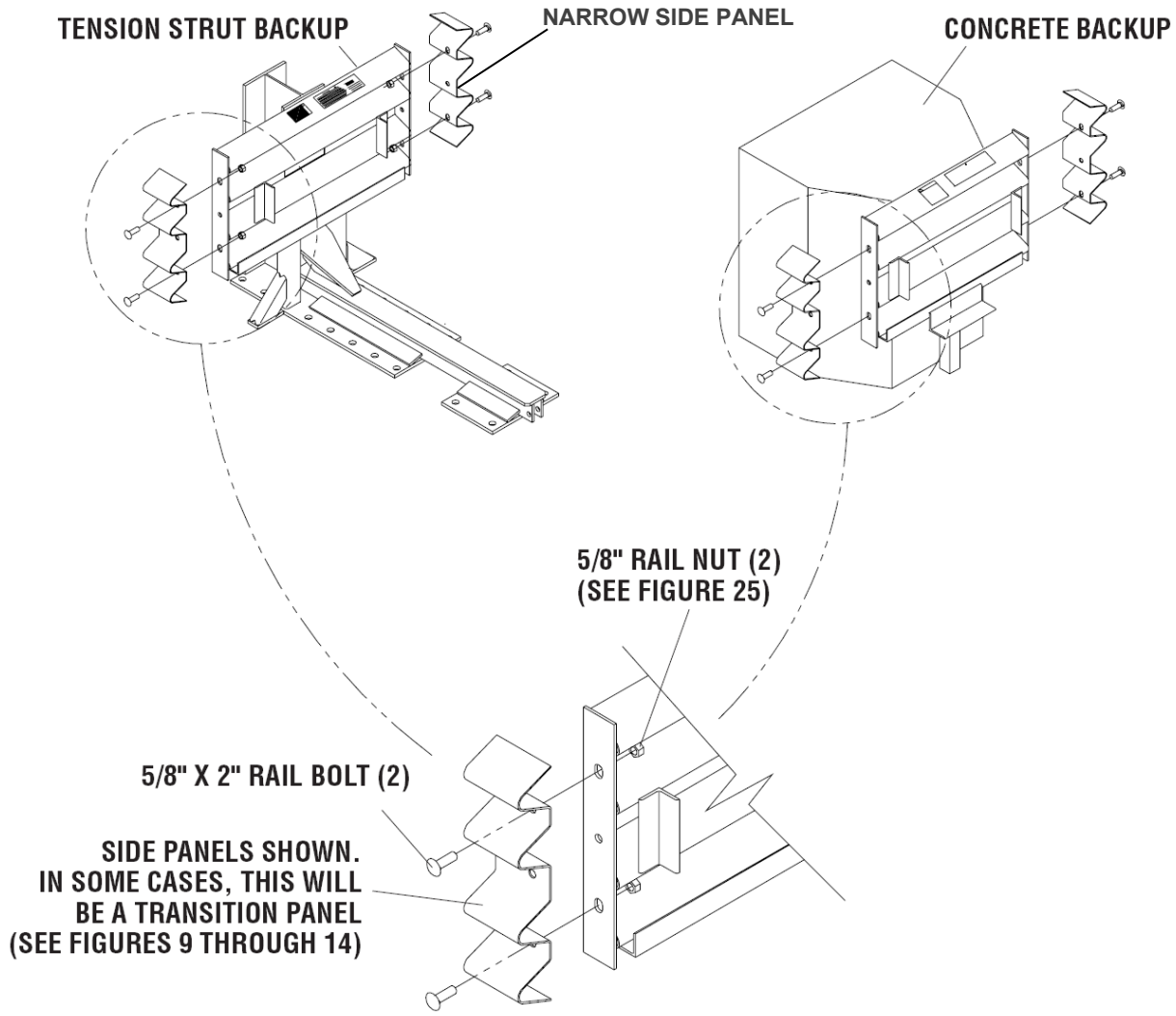


Figure 22
Side Panel/Transition Panel Attachment

6) Attach Monorail Guides

Attach Monorail guides to Diaphragm as shown in Figure 23.

Insert 3/4" x 2” G8 hex bolt through Monorail guide and Diaphragm, oriented as shown in Figure 22. Secure with 3/4" lock washer and 3/4" hex nut (typical 4 places). See also Diaphragm Assembly drawing.

Repeat process for each Diaphragm.

7) Attach Diaphragms

Orient a Diaphragm so that the front face of the Diaphragm shape faces toward the Nose of the system as shown in Figure 24. Slide one Diaphragm all the way to the Backup to ensure the system is able to collapse properly during impact. Once this has been verified, slide the Diaphragm forward to approximately 36” [915 mm] in front of the Backup. Orient and slide all other Diaphragms onto Monorail and position each approximately as shown in Figure 25.

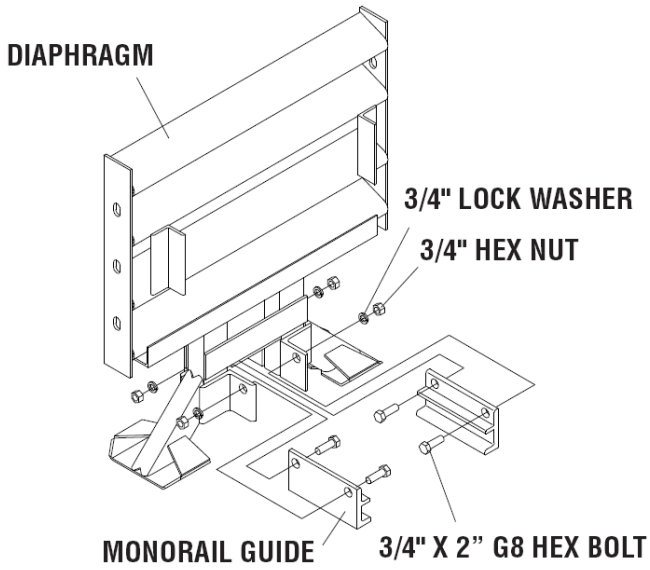


Figure 23
Monorail Guide Attachment

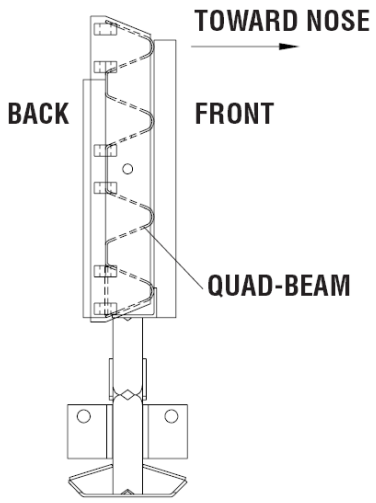


Figure 24
Diaphragm Orientation

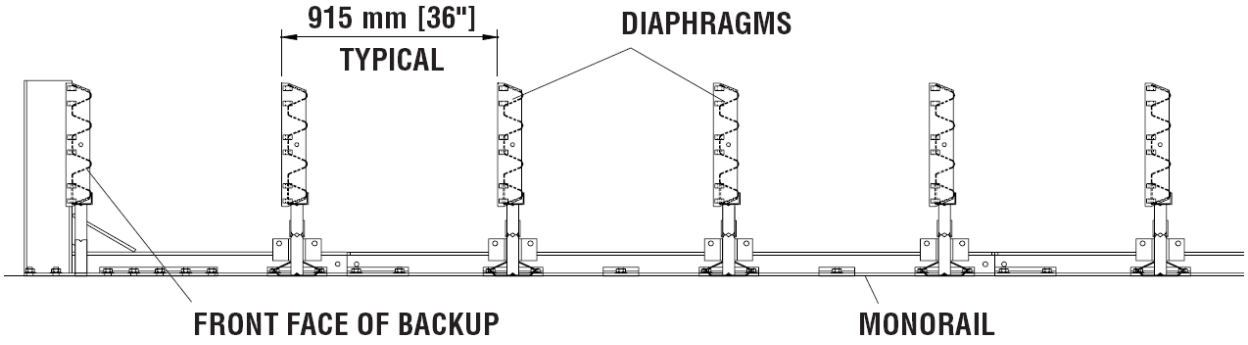


Figure 25
Diaphragm Spacing

8) Attach Fender Panels

Note: Do not mix the 5/8” rail nuts (large) with the 5/8” hex nuts (small) (Figure 26).

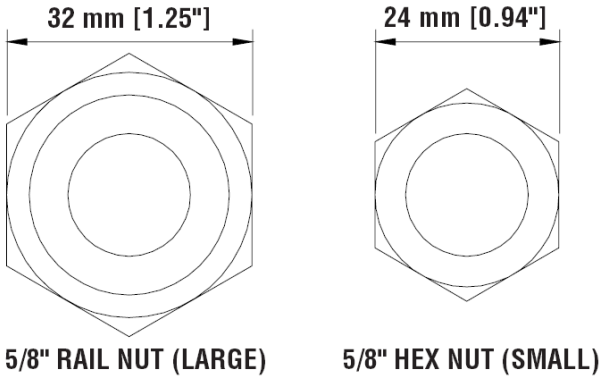


Figure 26
Rail Nuts are Oversize

Starting at the Backup, attach left and right Fender Panels shown on page 30 and Fender Panel Assembly drawing.

Step 1

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.

Attach Mushroom Washer Assembly as shown in Figure 27 and Detail 27a and Detail 27b but do not torque at this time. (This helps to balance the Fender Panel.)

Step 2

Slide the Fender Panel forward until the holes in the Fender Panel line up with the holes in the forward Diaphragm.

Step 3

Use a drift pin to align the center hole of the Fender Panel with the center hole of the Diaphragm.

Step 4

Attach the front of the Fender Panels to the next Diaphragm using two (2) rail bolts and large hex rail nuts per side. Use only the top and bottom holes; leave the center hole open until the next Fender Panel is attached.

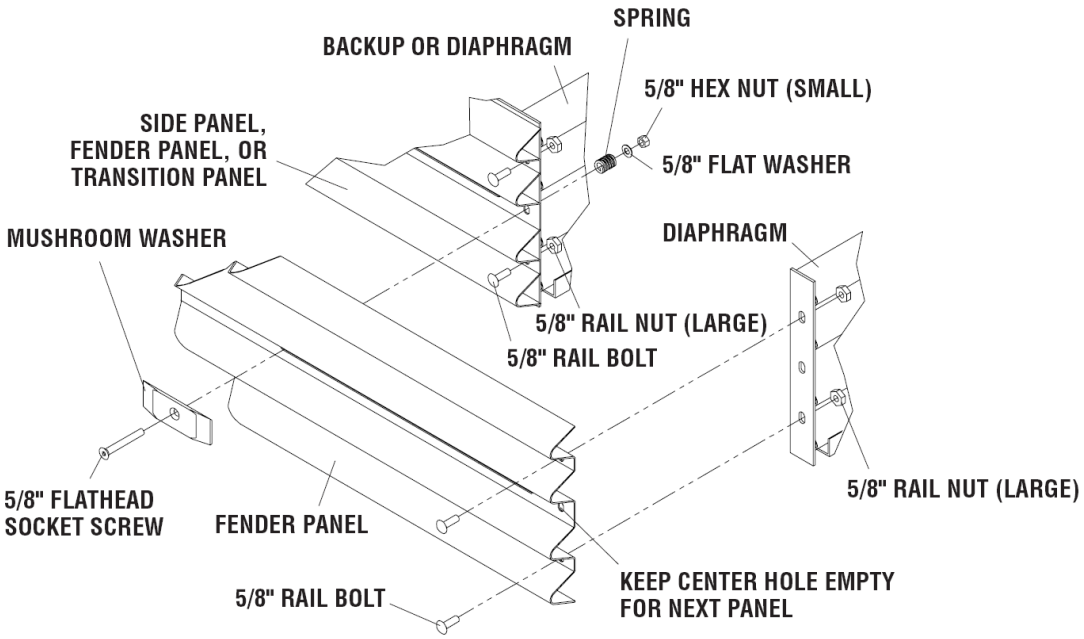
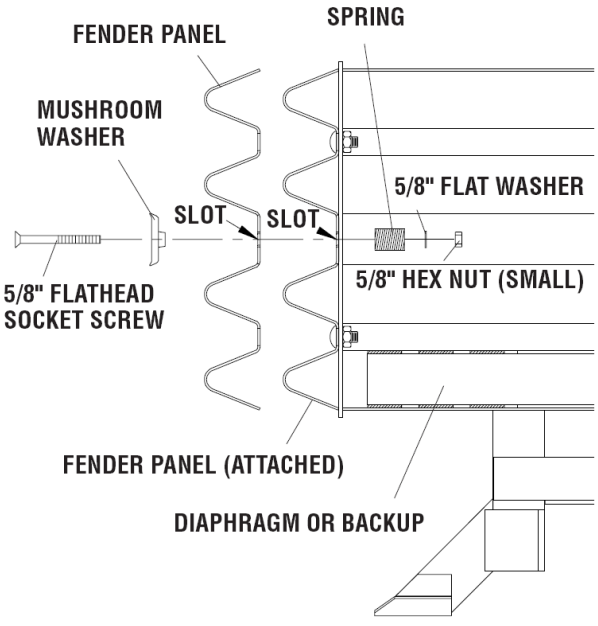


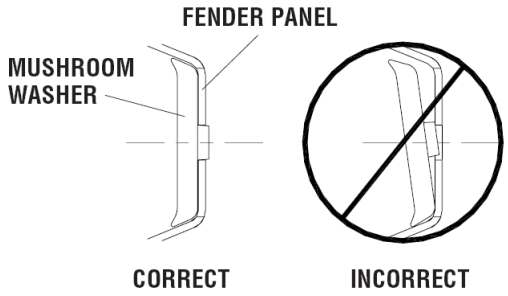
Figure 27
Fender Panel Assembly

Step 5

Be sure Mushroom Washer lays flat against the Fender Panel as shown in Figure 27b. Standoff on Mushroom Washer must be seated completely through slot.



Detail 27a
Mushroom Washer Attachment



Detail 27b
Mushroom Washer Orientation

Step 6

Check Diaphragm spacing to ensure 36” [915 mm] between rear faces of consecutive Diaphragms as shown in Figure 28 and Fender Panel Assembly drawing.

Step 7

Once proper spacing has been achieved, torque the Mushroom Washer Assembly (small hex) nut until it reaches the end of the threads.

Assemble the remaining Diaphragms and Fender Panels following the same procedures.

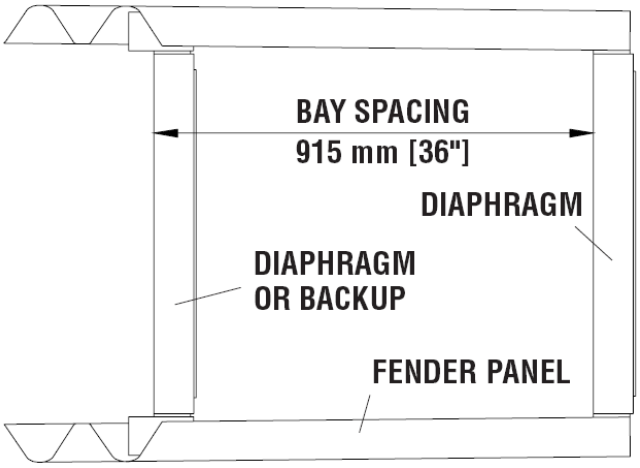


Figure 28
Proper Diaphragms Spacing

9) Attach End Cap

Using 5/8” x 3 1/2" G5 hex bolt, 5/8” hex nut and 5/8” lock washer, attach the End Cap to the front of the first Monorail segment, as shown in Figure 29 and Monorail Assembly drawing.

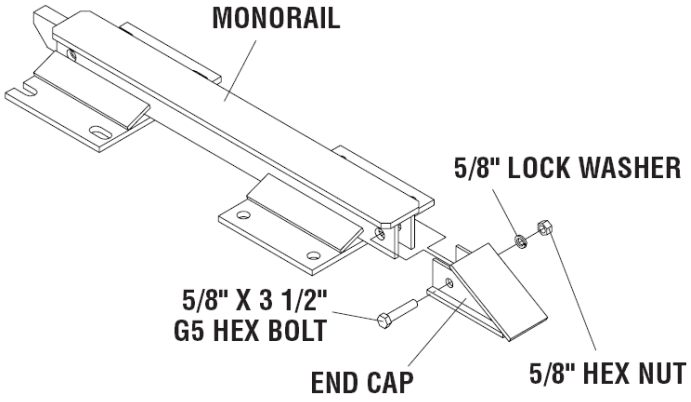


Figure 29
Monorail End Cap Assembly

10) Attach Cartridge Support Brackets

Attach lower Cartridge Support Bracket to front and back of all Diaphragms and front of Backup as shown in Figures 31 to 33, the Diaphragm Assembly drawings and the Backup Assembly drawings (p. 35).

Note: 24” [610 mm] wide systems do not have Side Cartridge Support Brackets: 30” [762 mm], 36” [914 mm] and 48” [1219 mm] wide systems have Side Cartridge Support Brackets welded to the Backup and Diaphragms.

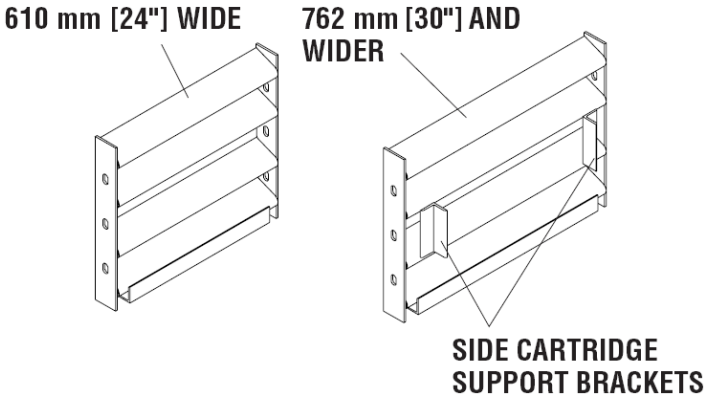


Figure 30
Side Cartridge Support Brackets

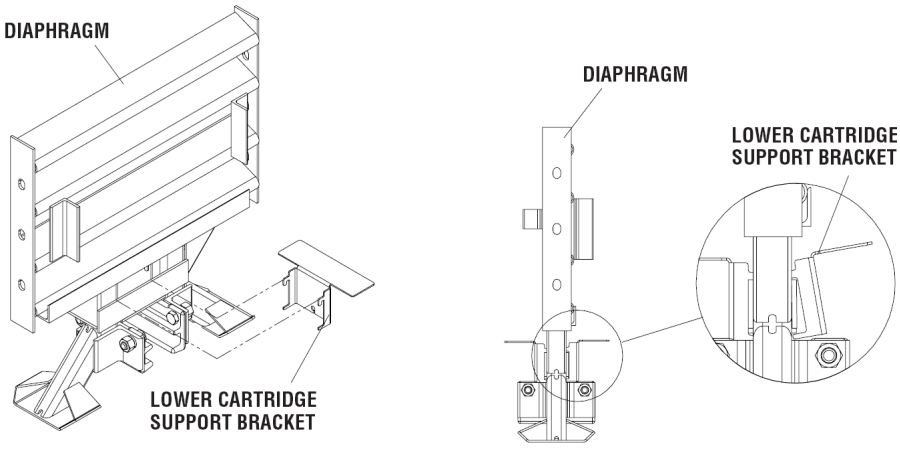


Figure 31
Lower Cartridge Support Bracket Assembly

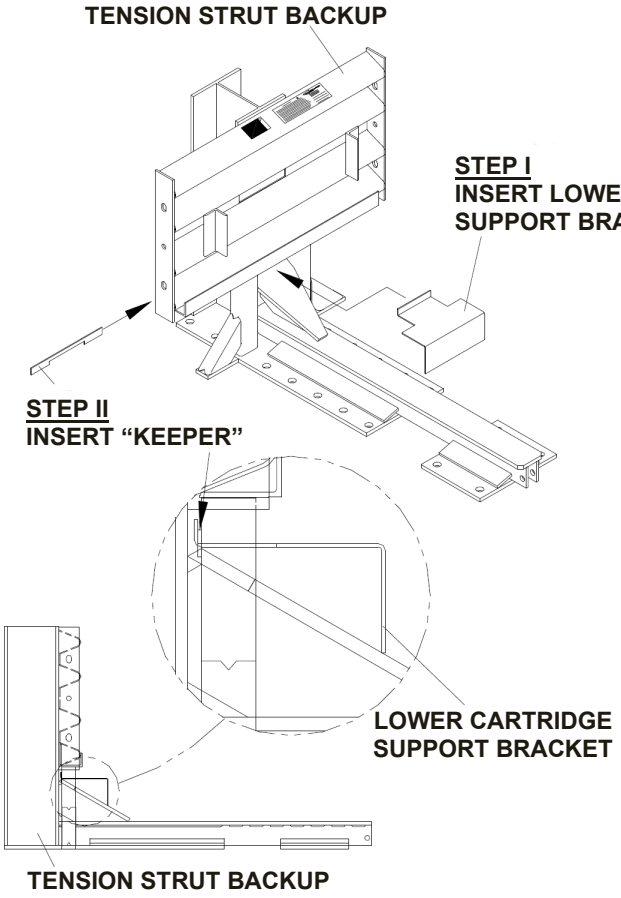


Figure 32
Lower Cartridge Support Bracket
(Tension Strut Backup)

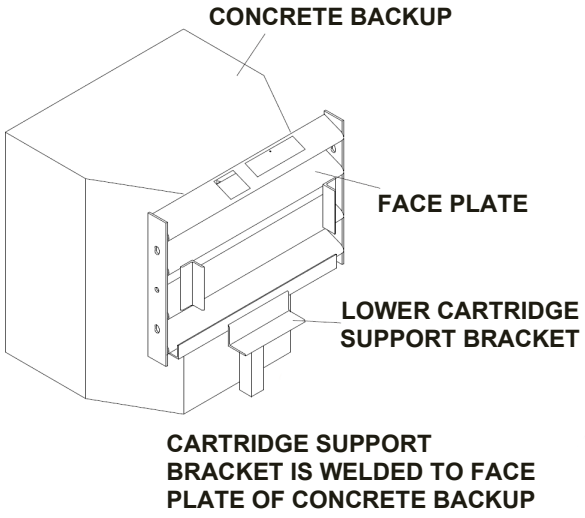


Figure 33
Lower Cartridge Support Bracket
(Concrete Backup)

Attach Nose

11a) Attach Plastic Nose Assembly

Determine which style of Cartridges your system has. If your system has Cartridge style A as shown in Figure 34, attach Cartridge Support in the upper two slots as shown.

If your system has Cartridge style B as shown in Figure 34, attach Cartridge Support in the lower two slots as shown.

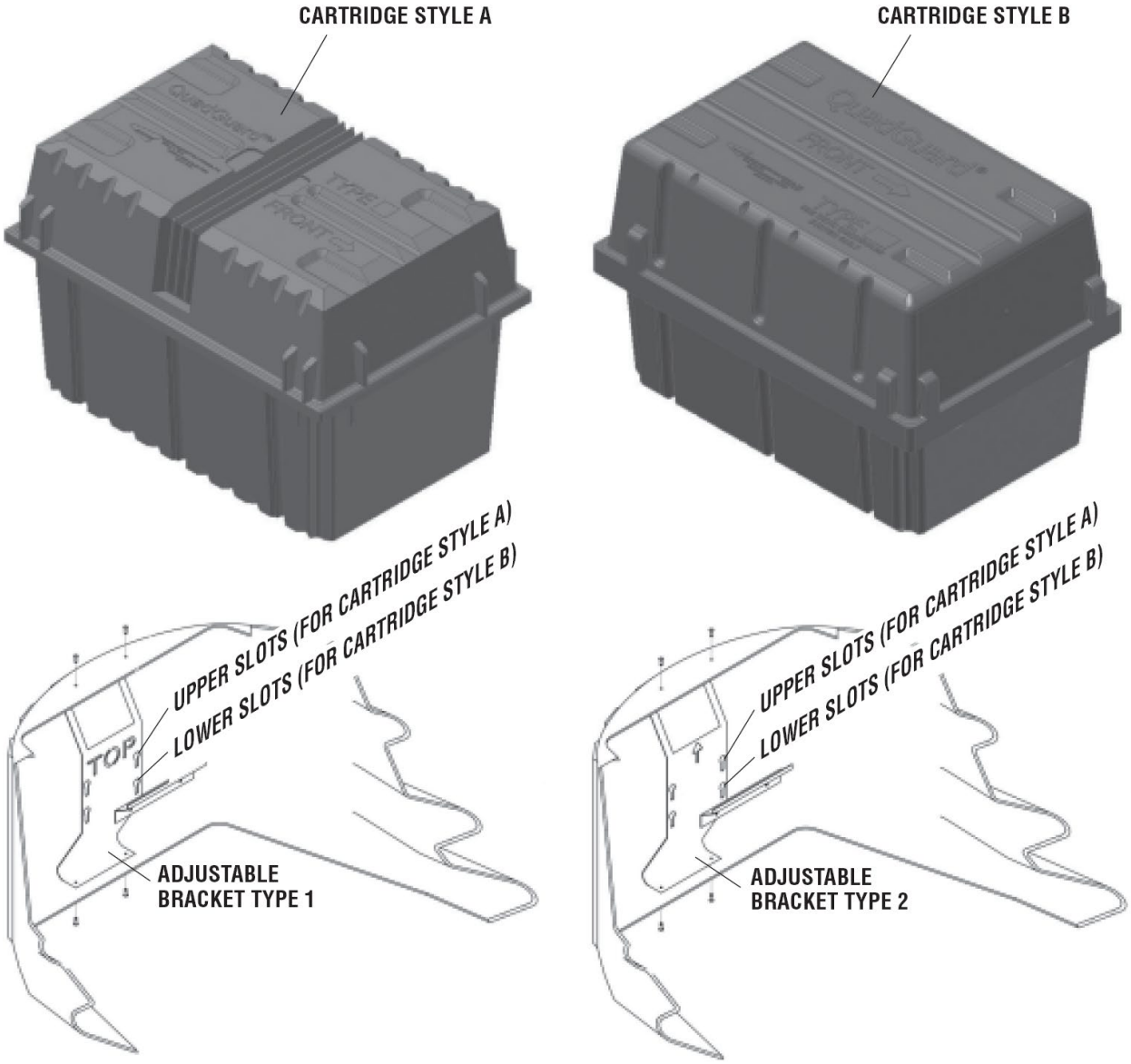
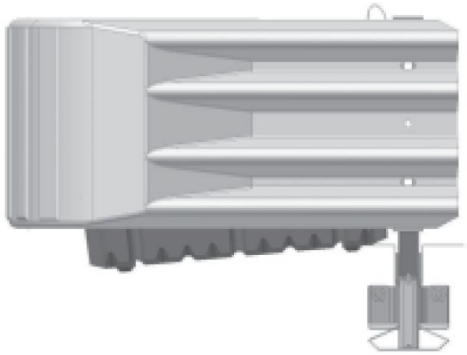


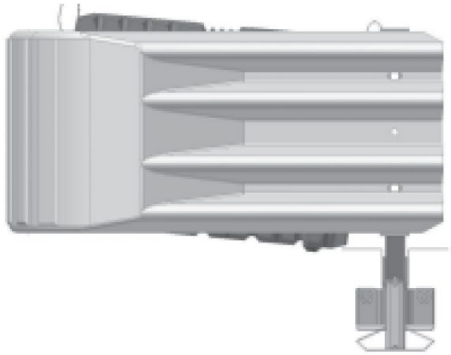
Figure 34
Adjustable Bracket Locations

As shown in Detail 34a, Cartridge Style A is attached with the Adjustable Support Bracket **incorrectly** in the lower position.



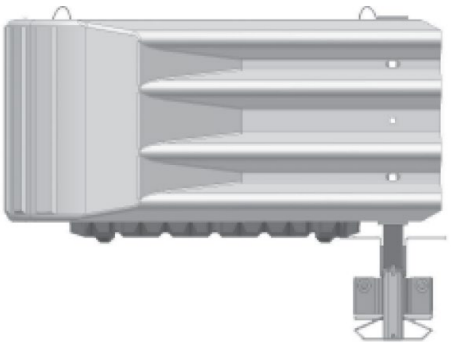
Detail 34a
<u>Incorrect</u> Attachment of Adjustable Cartridge Support Bracket

As shown in Detail 34b, Cartridge Style B is attached with the Adjustable Cartridge Support Bracket **incorrectly** in the upper position.



Detail 34b
<u>Incorrect</u> Attachment of Adjustable Cartridge Support Bracket

Detail 34c shows the Adjustable Cartridge Support Bracket attached **correctly.**

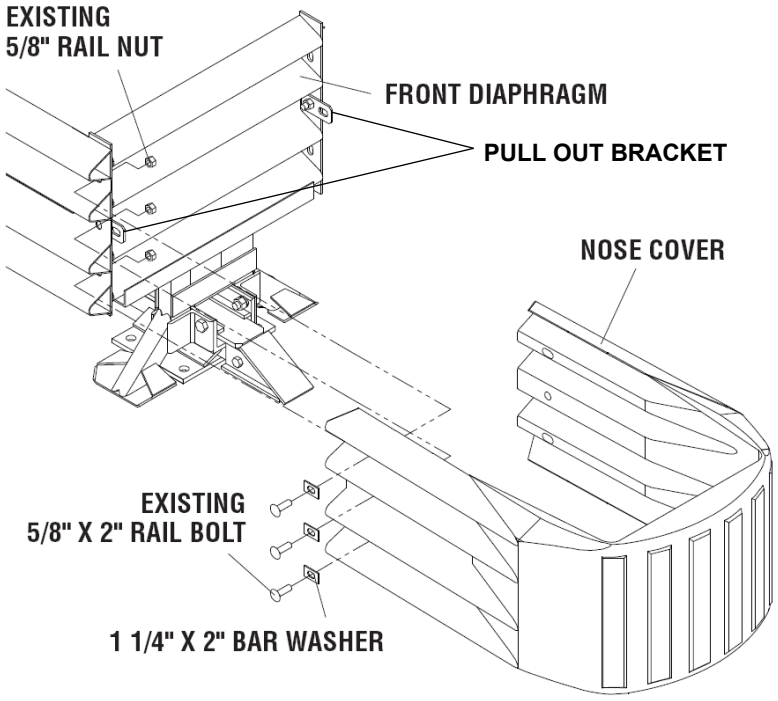


Detail 34c
<u>Correct</u> Attachment of Adjustable Cartridge Support Bracket

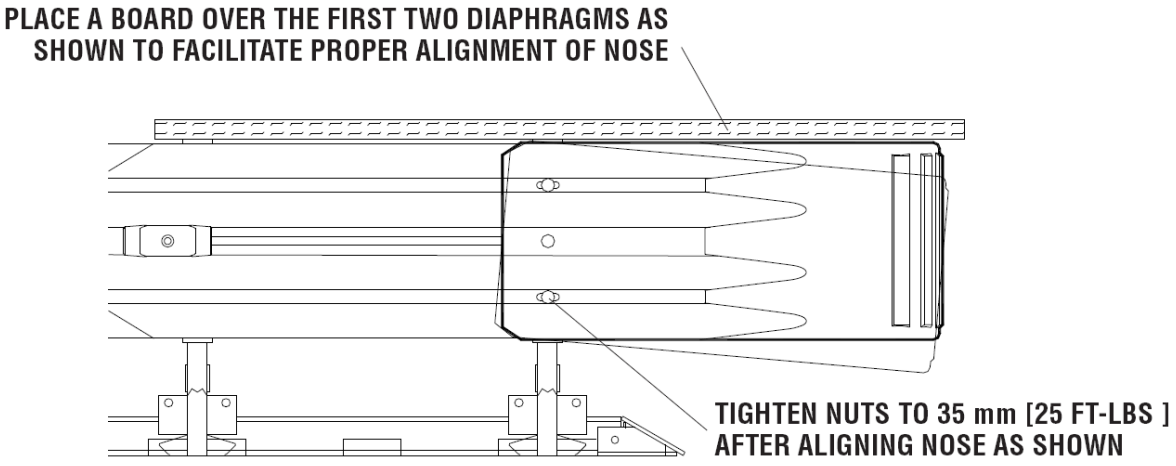
Bolt the Nose Assembly directly to the Front Diaphragm, as shown in Detail 34d and the Nose Assembly drawings, using six (6) rail bolts which also hold the front two Fender Panels to the Diaphragm with Bar Washer under each bolt.

Place Pullout Brackets under center nuts.

The top and bottom holes of the Nose are slotted to provide adjustment. Adjust so the top edge of the Nose is level with the top edge of the Fender Panels and then torque all six (6) nuts to 25 lbf-ft [35 N-m].



Detail 34d
Nose Assembly



Detail 34e
Adjust Nose

11b) Optional Belt Nose Assembly

a. Using 5/8” x 5” hex bolt, two (2) 5/8” x 1 3/4" flat washers and 5/8” hex nut, attach Fender Panel to front Diaphragm top and bottom as shown in Figure 35 (two places per side).
b. Using 5/8” x 5” hex bolt and 5/8” hex nut, attach Pullout Bracket to front Diaphragm and Fender Panel middle as shown (one place per side).
c. Thread second 5/8” nuts onto the attached bolts. Be sure the faces of the nuts are flush with humps on Fender Panels (Figure 35). Slide third 5/8” x 1 3/4” flat washers onto bolts (three places per side).
d. Align holes in each end of the Nose Belt with the attached bolts (three per side) and slide Nose Belt onto bolts.
e. Align holes in Belt Clamps with bolts and slide Belt Clamps onto bolts.
f. Using fourth 5/8” x 1 3/4" flat washer and third 5/8” hex nut, secure the Belt Clamps and Nose Belt (three places per side).

Refer also to Nose Belt Assembly drawing.

Note: Nose alignment shown in Figure 34e not necessary with Nose Belt Assembly (p. 38).

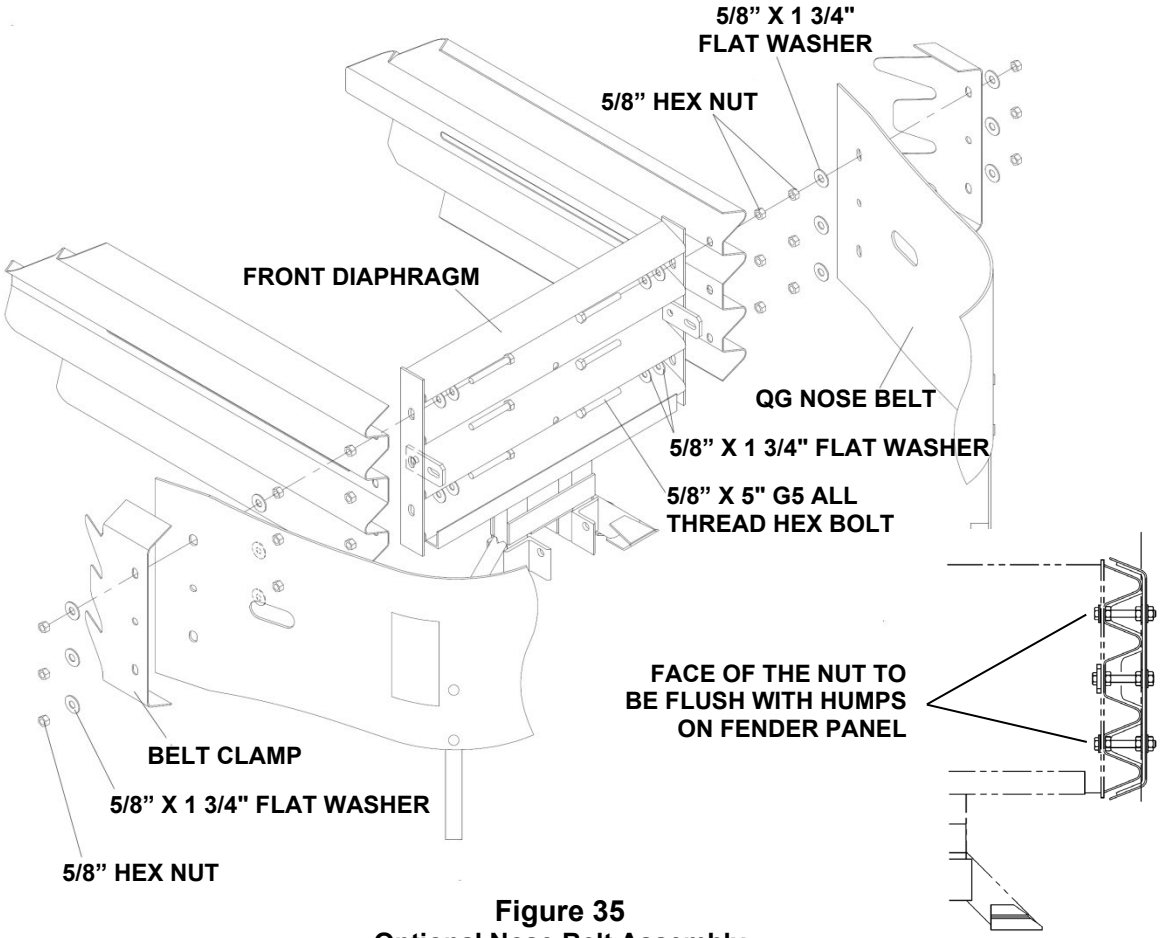


Figure 35
Optional Nose Belt Assembly

Note: Nose of system may be delineated to comply with local codes (chevron, reflective material, signs, etc. supplied by others).

12) Checking the System Assembly

At this point recheck to ensure that all fasteners are properly tightened throughout the system (anchor bolts, etc.). See warning below. Check all Fender Panels. If they do not fit tightly against the underlying Panel, system realignment may be necessary (Figure 36).

Warning:
Bolt Torque Requirements
Anchor Studs – p. 12 May slightly protrude above nuts
Critical Clearances
Anchor Studs above nuts – Figure 20, p. 25 Fender Panel Gap Narrow – 0.78” [20 mm]

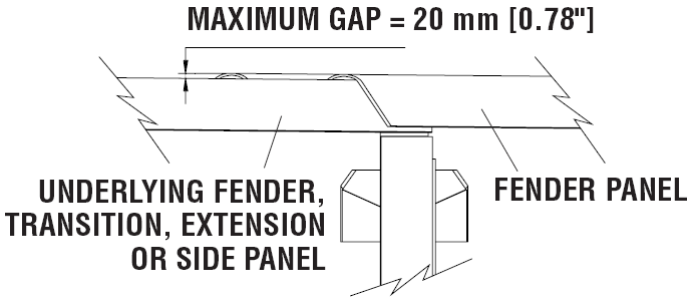


Figure 36
Fender Panel Gap for Narrow Systems

13) Cartridge Assembly

Be sure the Adjustable Cartridge Support in the Nose is attached correctly. See “Attach Nose Assembly” in Step 11 on page 33. The top surface of the Nose Cartridge should be horizontal.

It is the responsibility of the installer to place the appropriate Cartridge in each Bay and Nose section of the QuadGuard®. Type 1 Cartridges are placed toward the front (Nose) of the system; Type II Cartridges are placed toward the rear (Backup) of the system (p. 38).

Warning: Placing the wrong Cartridge in the Nose or any Bay is strictly prohibited pursuant to NCHRP Report 350 testing criteria. Such configurations have not been accepted for use and may result in unacceptable crash performance.

I-TYPE I CARTRIDGE
II-TYPE II CARTRIDGE

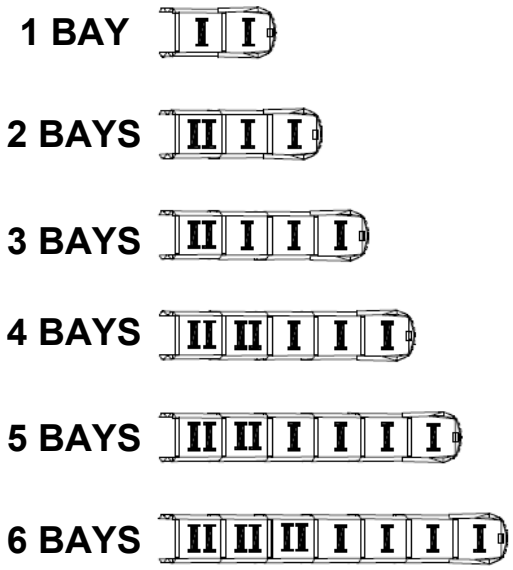


Figure 37
Cartridge Placement

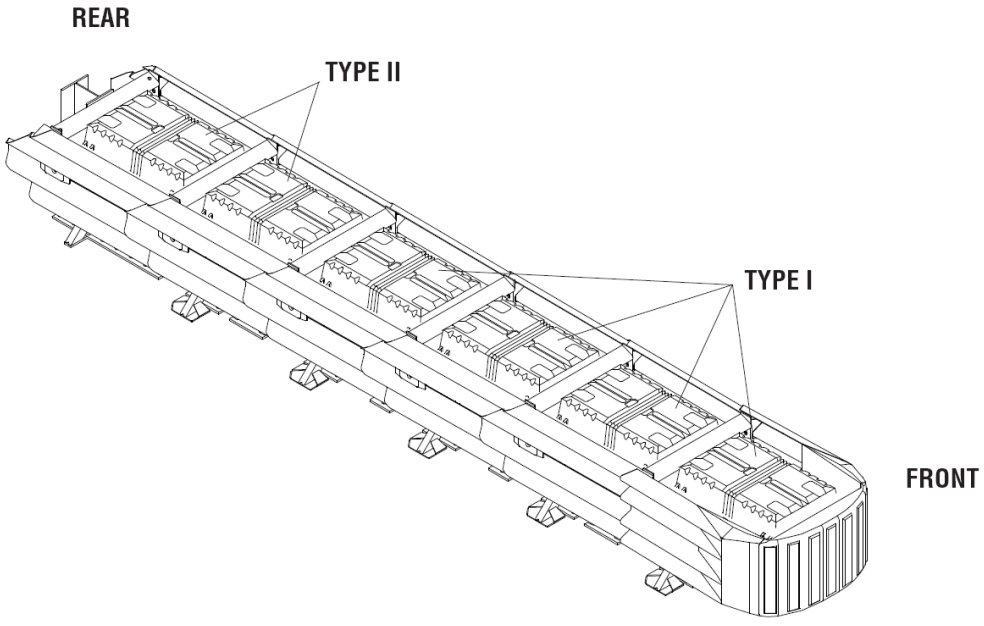


Figure 38
5-Bay Cartridge Placement Shown

Wide System Identification

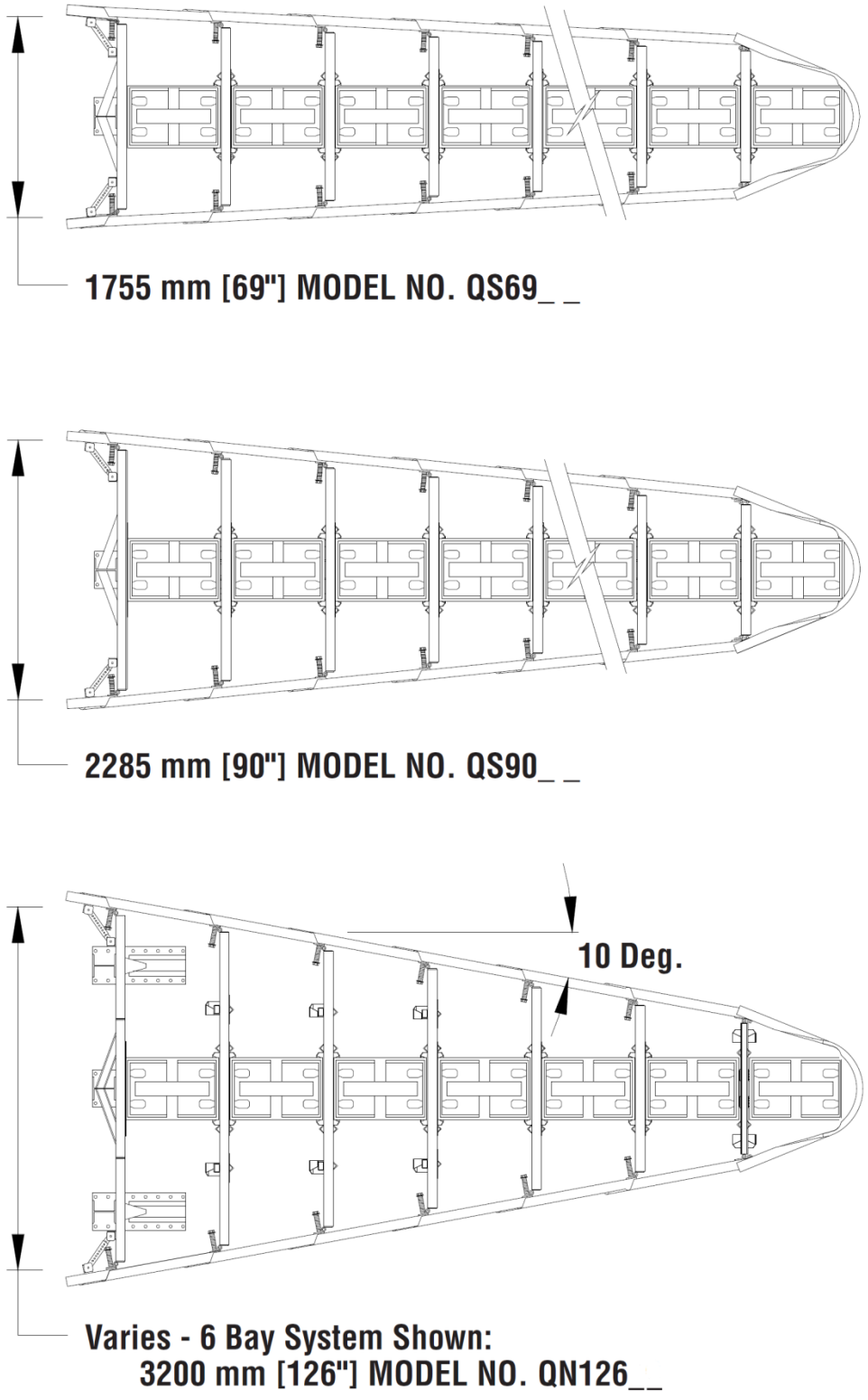


Figure 39
Wide Systems and Model Numbers

Inspect Shipping

Check all received parts against the shipping list supplied before QuadGuard® deployment. Make sure all parts have been received.

Caution: The Drawing Package supplied with the QuadGuard® must be used with these instructions for proper assembly and should take precedence over these general instructions.

Determine Backup and Transition Type

The QuadGuard® is available with a Tension Strut Backup or a Concrete Backup. See Figures 40 and 41, along with the Backup assembly drawing, to determine which type of Backup is being deployed.

A Transition Panel or Side Panel must 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®. See Figures 42 through 46 and the drawing package to determine which types of panels to attach.

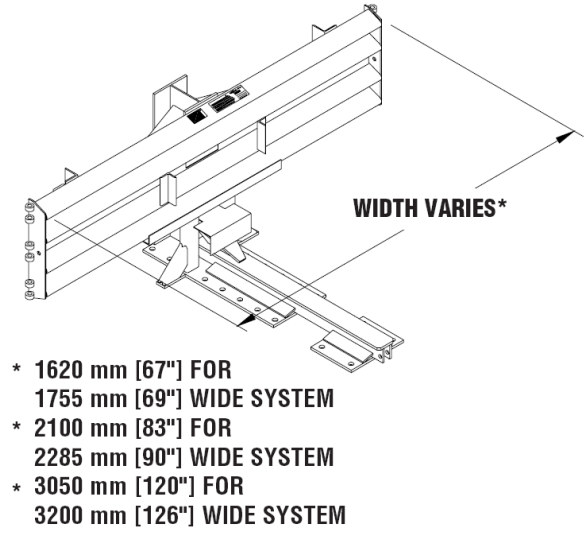


Figure 40
Tension Strut Backup

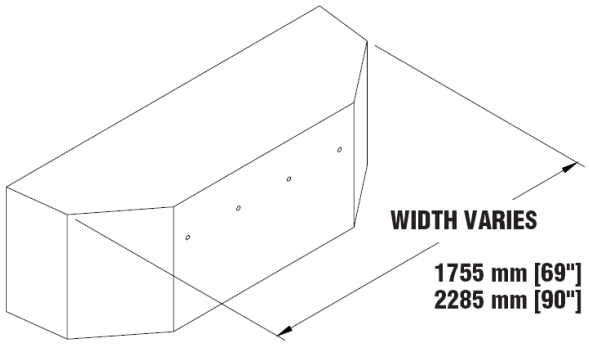


Figure 41
Concrete Backup

Wide Transitions

Note: The proper Transition Panel or Side Panel must be used for impact performance of the system. The correct Panel(s) to use will depend on the direction of traffic and what type of barrier or roadside feature the QuadGuard® is shielding. Contact the Customer Service Department prior to deployment if you have any questions.

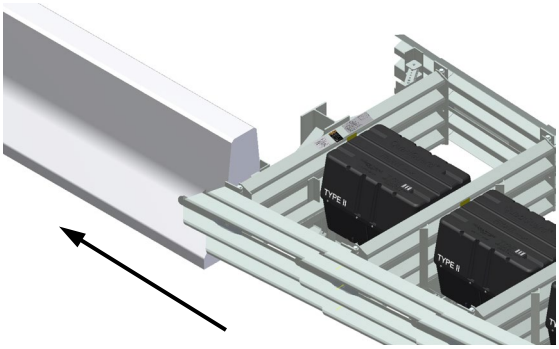


Figure 42
No Transition

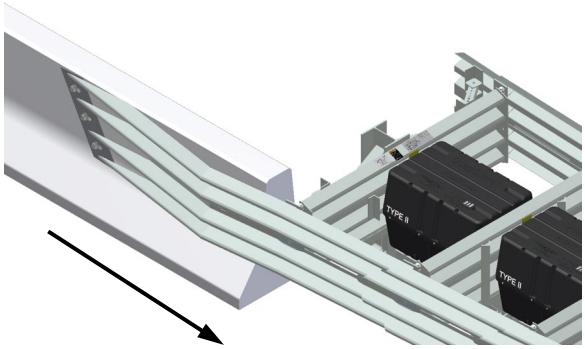


Figure 43
Quad-Beam™ to Safety Shape Barrier

Note: Arrows indicate traffic direction.

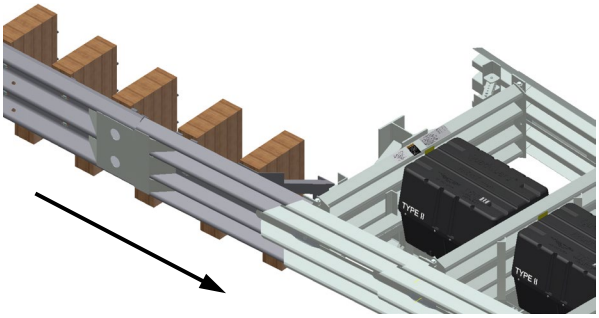


Figure 44
Quad-Beam™ to Thrie-Beam

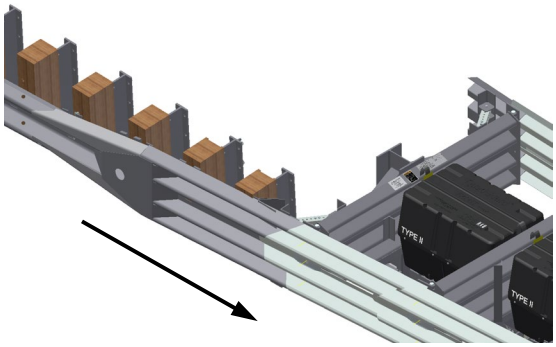


Figure 45
Quad-Beam™ to W-Beam

Note: Arrows indicate traffic direction.

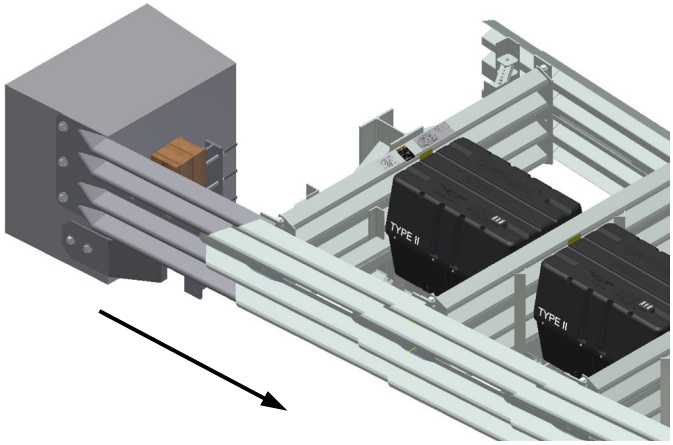


Figure 46
Quad-Beam™ End Shoe

Assembly Wide

1) Mark System Location

Locate the centerline of the system by measuring the proper offset from the roadside obstacle. See the Drawing Package supplied with the system. Place chalk line to mark the centerline of the system. Mark a construction line parallel to the center line and offset 6.5” [165 mm] to one side as shown in Figure 47. The edge of the Monorail will be placed on this line.

Note: The concrete foundation must comply with the project plans supplied with the system.

Warning: Location of system with respect to the roadside obstacle is critical and dependent on the type of Transition Panel used. See the Project Plans supplied with the system for details.

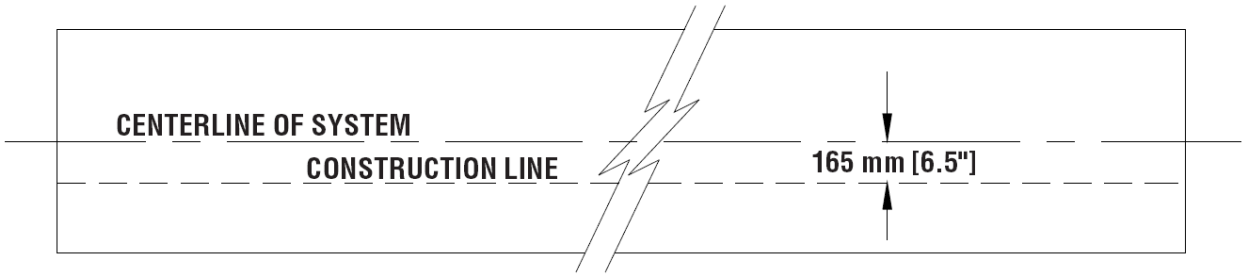


Figure 47
(Top view of concrete foundation)

2) Anchor the Backup

A) Concrete Backup Construction (Figure 48)

Locate Backup Face Plate using the Backup assembly drawing. Verify that any applicable Transition Panels fit properly before anchoring the Face Plate. Drill anchor holes in the Concrete Backup using the Face Plate as a template. Anchor the Face Plate to the Concrete Backup using the approved adhesive anchoring system supplied with the QuadGuard® (p. 12).

Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

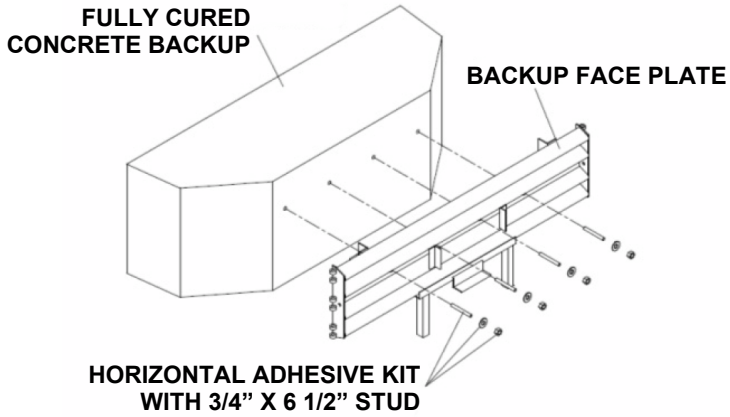


Figure 48
Anchor Backup Face Plate to Concrete Backup

B) Monorail Assembly for Tension Strut Backup

Locate the Tension Strut Backup on foundation with side of Monorail on the construction line on page 46 (Figure 52). Verify that any applicable Transition Panels fit properly before anchoring Backup. Drill anchor holes in foundation using the Backup as template. Anchor the Backup to the concrete foundation using the approved adhesive kit supplied with the QuadGuard® (p. 12).

Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

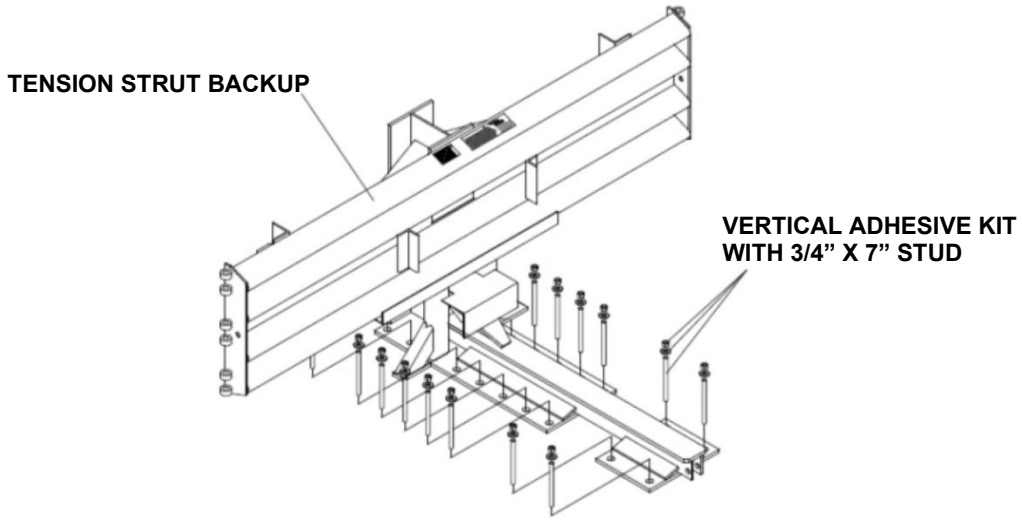


Figure 49
Anchoring Tension Strut Backup to Foundation

Monorail Alignment

It is important to align each segment of Monorail from the back to the front of the system (±1/4" [6 mm]). Anchor each Monorail section using the provided Valtir approved adhesive kit. See Figure(s) 50, 52 - 54 and the approved adhesive instructions included with the adhesive kit (p. 12).

Drill 0.78" [20 mm] diameter by 5 3/4" [145 mm] boreholes using the Monorail as a template. Do not drill through foundation.

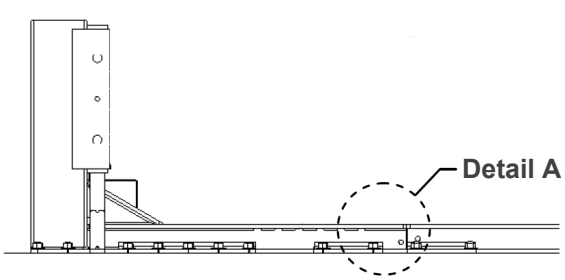
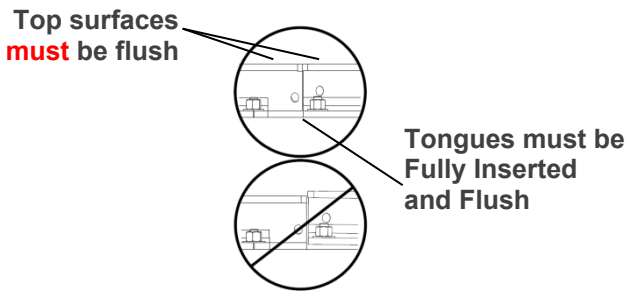


Figure 50
Rail Height and Alignment



Detail A

C) Extra-Wide Tension Strut Backup Assembly (Figure 51)

Locate the Extra-Wide Tension Strut Backup center section and Monorail on foundation with side of Monorail on the construction line (p.44).

Locate the Extra-Wide Tension Strut Backup left section on the left side of the center section, aligning the three holes in the side plates.

Locate the Extra-Wide Tension Strut Backup right section on the right side of the center section, aligning the three holes in the side plates.

Secure the Backup sections to each other using 5/8” x 2” hex bolt, 5/8” x 1 3/4" flat washer (2), 5/8” lock washer and 5/8” hex nut (6 places) as shown in Figure 51 and Detail 51A.

Verify that any applicable Transition Panels fit properly before anchoring Backup. Drill anchor holes in foundation using the Backup as template. Anchor the Backup to the foundation using an approved adhesive supplied with the QuadGuard®.

Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

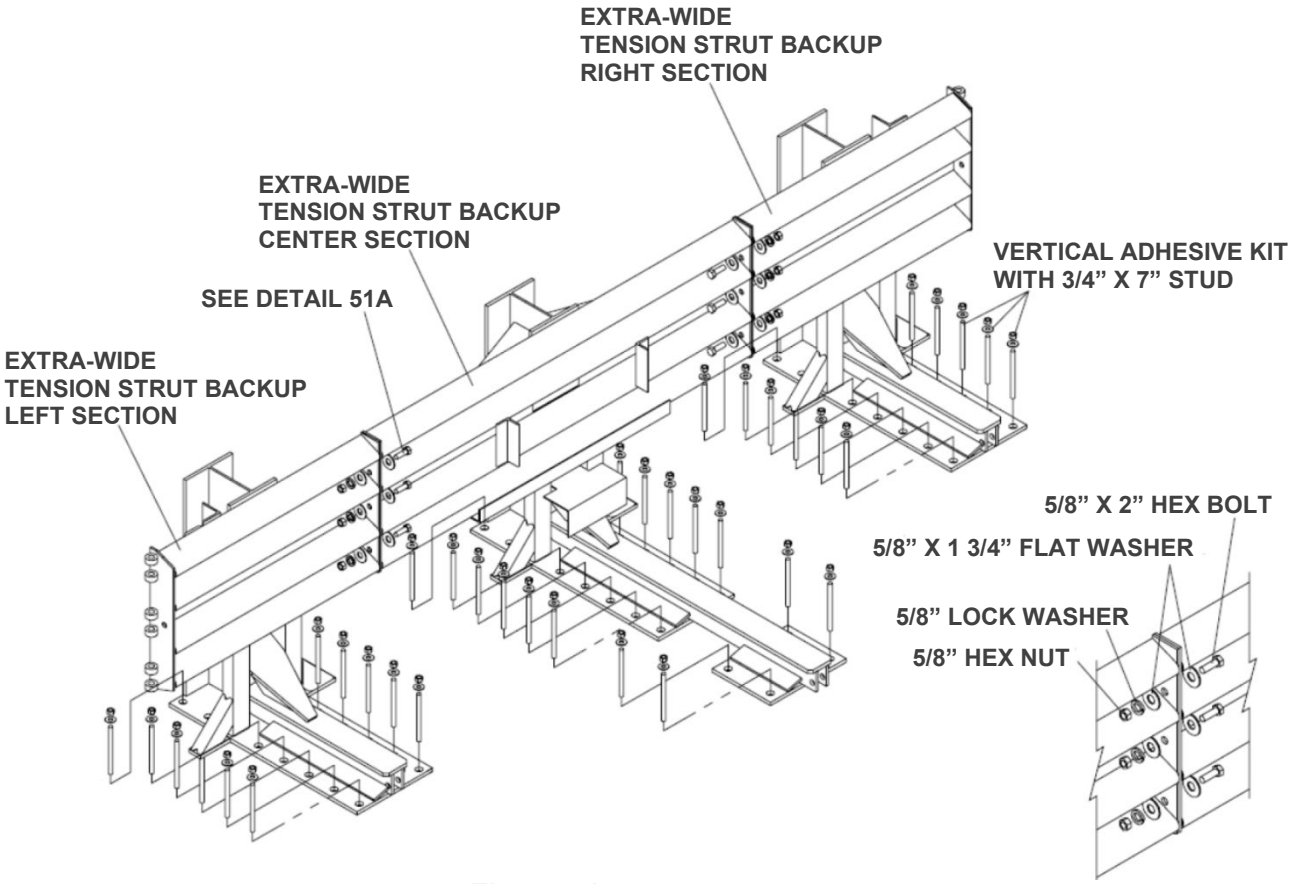


Figure 51
Anchoring Extra-Wide Tension Strut Backup

Detail 51A

4) Anchor the Monorail

A) Monorail Assembly for Concrete Backup (Figure 52).

Locate Monorail on foundation with side of Monorail on the construction line and rear edge of Monorail foot forward of front face of Concrete Backup (Figure 52).

Orient the Monorail so that the Monorail tongues face the Concrete Backup (Figure 52).

Drill 5 1/2" [140 mm] deep anchor holes using the Monorail as a template. Do not drill through foundation.

Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

Anchor each Monorail section using the approved adhesive kits provided. See Figure 51 and the approved adhesive kit instructions included with this manual (p. 12). It is important to attach each segment of Monorail in alignment from the back to the front of the system (±1/4” [6 mm]).

Warning: Improper alignment at the Monorail Splice Joints will prevent proper system collapse during an impact.

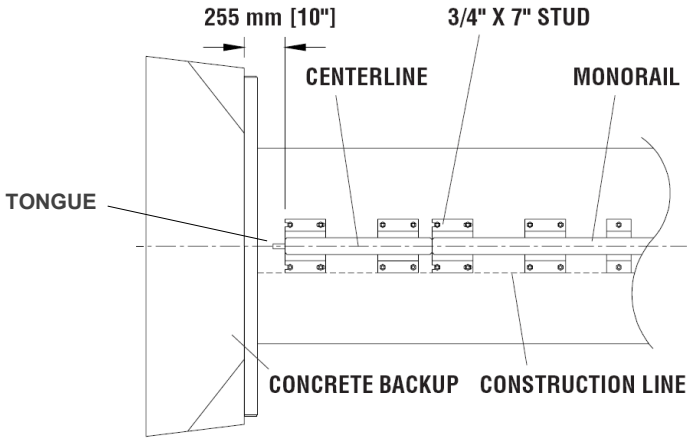


Figure 52
Monorail Location for Concrete Backup

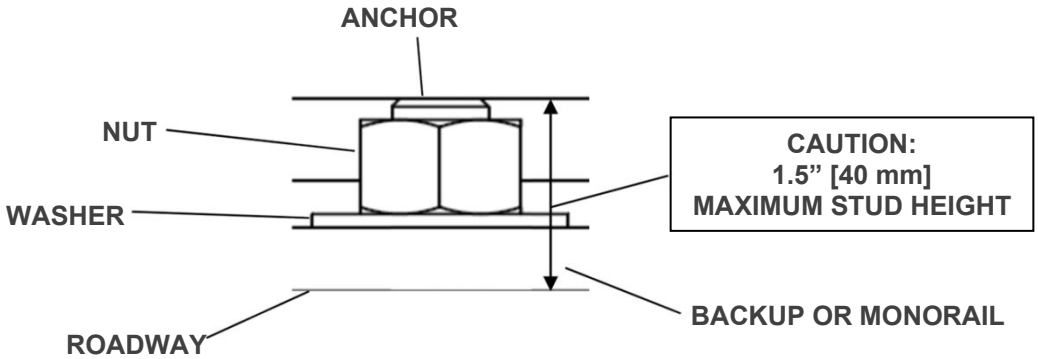


Figure 53
Proper Stud Height

B) Monorail Assembly for Tension Strut Backup (Figure 54).

Locate Monorail on foundation with side of Monorail on the construction line and rear edge of Backup foot 4” forward of edge of foundation (Figure 54).

Drill 5 1/2” [140 mm] deep anchor holes using the Monorail as a template. Do not drill through foundation.

Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

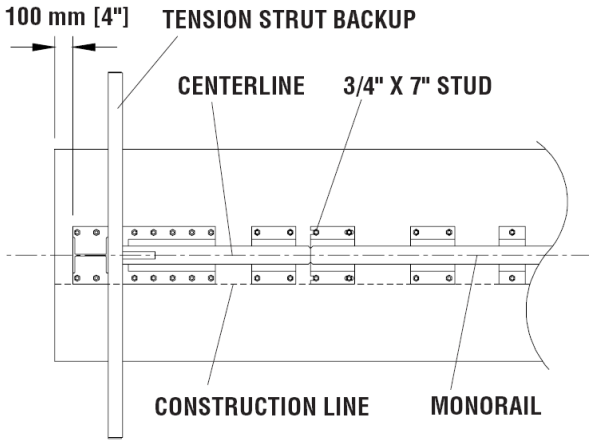


Figure 54
Backup and Monorail Location for Tension Strut Backup

5) Attach Side Panels and/or Transition Panels to Backup Assembly (Figure 55).

a. Attach Hinge Plate to the Transition Panel or Side Panel using 5/8” rail bolt and 5/8” rail nut (two places – top and bottom holes only).

b. Attach Transition Panel or Side Panel assembly to side of Backup using 5/8” x 4” hex bolt, 5/8” lock washer and 5/8” hex nut at three places on each side of Backup (Figure 55).

c. Attach diagonal brace to Fender Panel and Backup using 3/8” hex bolt, 3/8” lock washer and 3/8” hex nut (two places per brace: 4 places per side).

d. Secure each diagonal brace with 3/8” hex bolt, 3/8” lock washer, and 3/8” hex nut (two places per brace) as shown in Figure 55.

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

Assembly tip:

Use drift pin to align the center hole of the Panel with the center hole of the Backup before attaching the rail bolts.

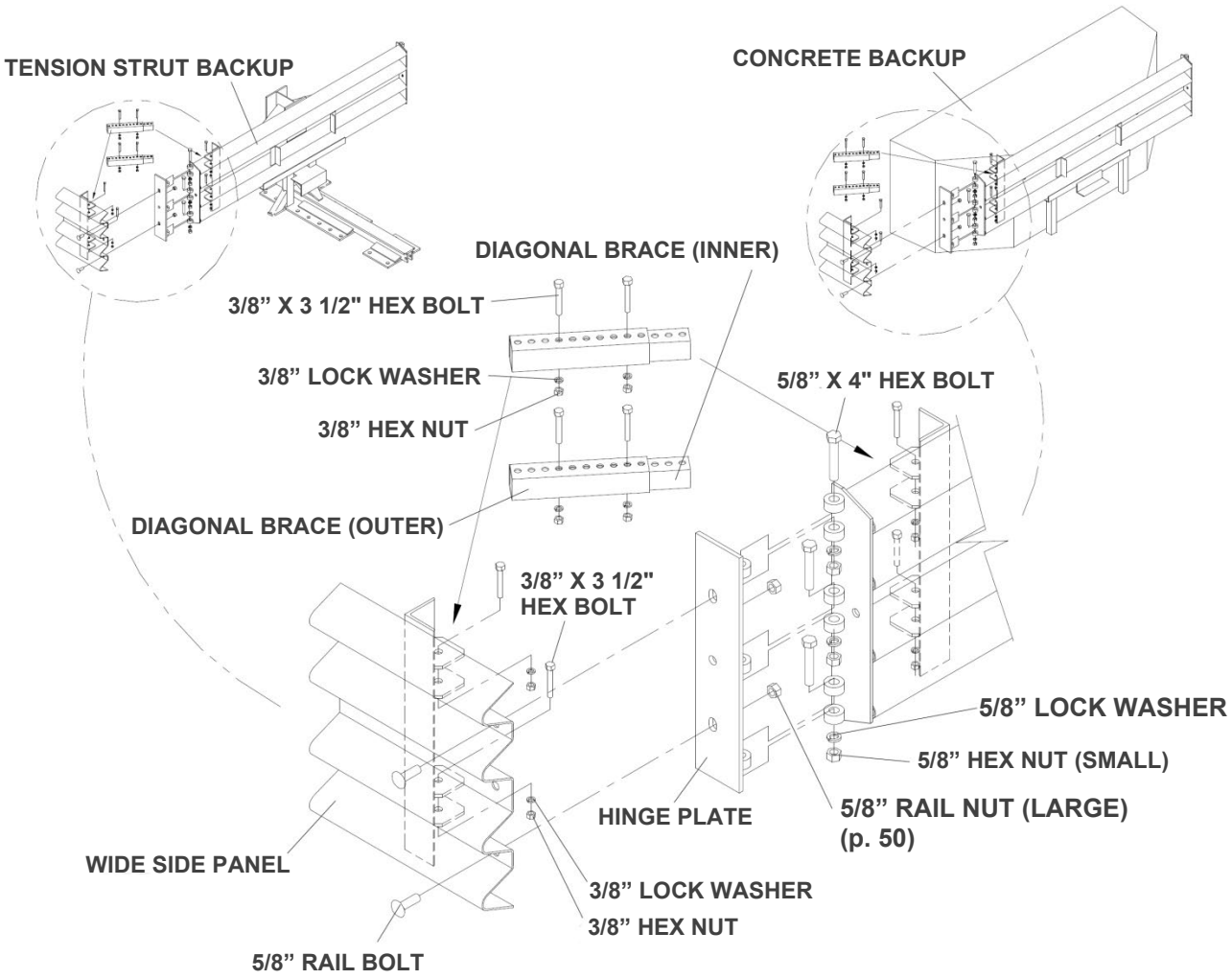


Figure 55
Side Panel/Transition Panel Attachment

6) Attach Monorail Guides

Insert 3/4” x 2” G8 hex bolt through Monorail guide and Diaphragm, oriented as shown in Figure 56. Secure with 3/4” lock washer and 3/4” hex nut (typical two places per guide). See also Diaphragm assembly drawing. Shims are sandwiched between Monorail guides and Diaphragm.

Repeat process for each Diaphragm.

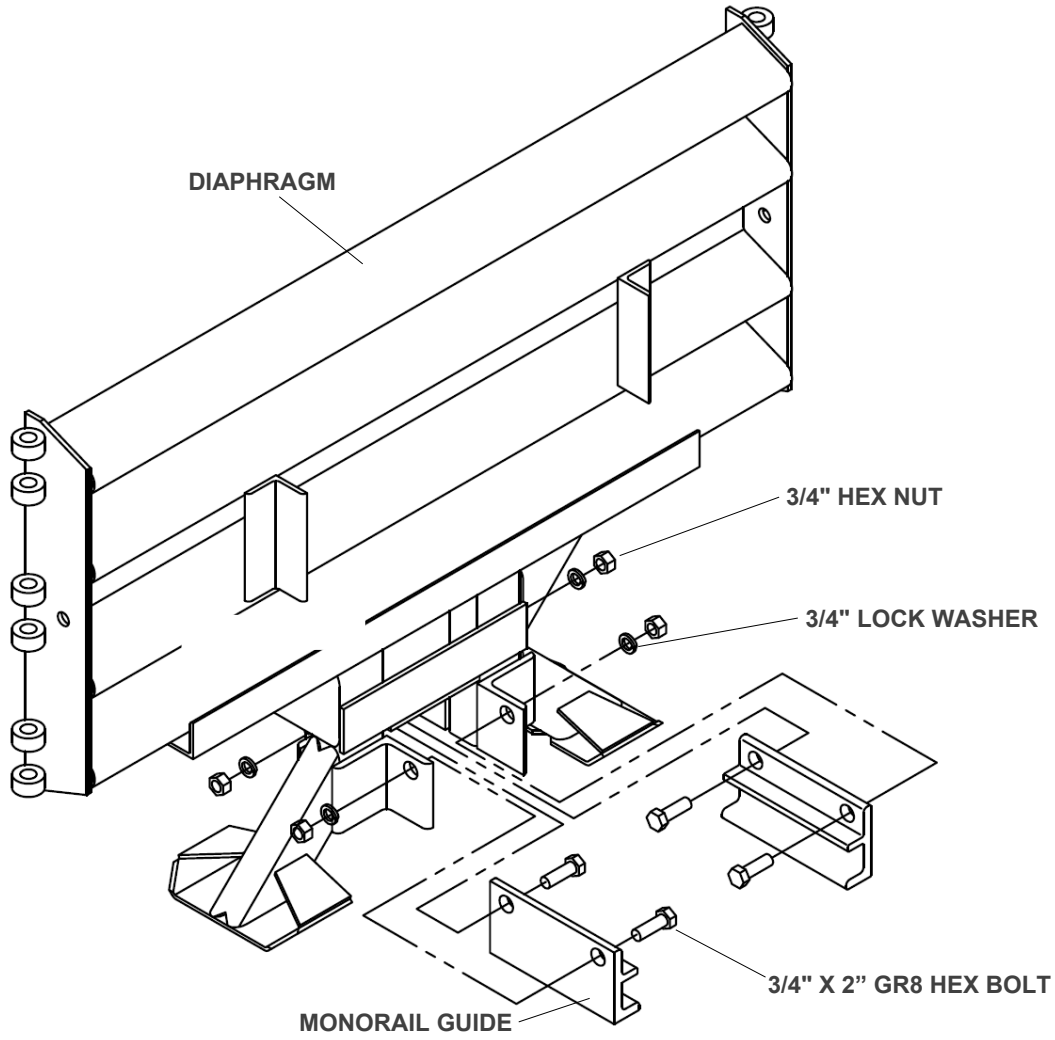


Figure 56
Monorail Guide Attachment

7) Attach Diaphragms

Orient the widest Diaphragm so that the front face of the Diaphragm shape faces toward the Nose of the system as shown in Figure 57. **The widest Diaphragm must be attached closest to the Backup with each subsequent Diaphragm being progressively narrower.**

Slide the widest Diaphragm onto the Monorail and all the way to the Backup to ensure system is able to collapse properly during impact. Once this has been verified, slide the Diaphragm forward to approximately 36” [915 mm] in front of the Backup.

Orient and slide all other Diaphragms onto Monorail and position each approximately as shown in Figure 58.

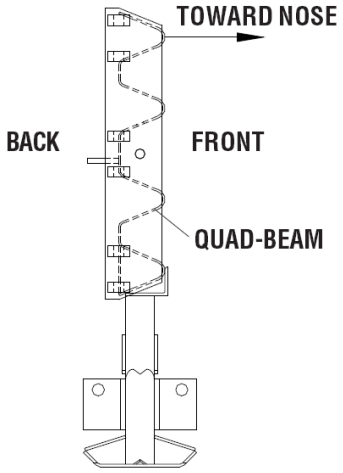


Figure 57
Diaphragm Orientation

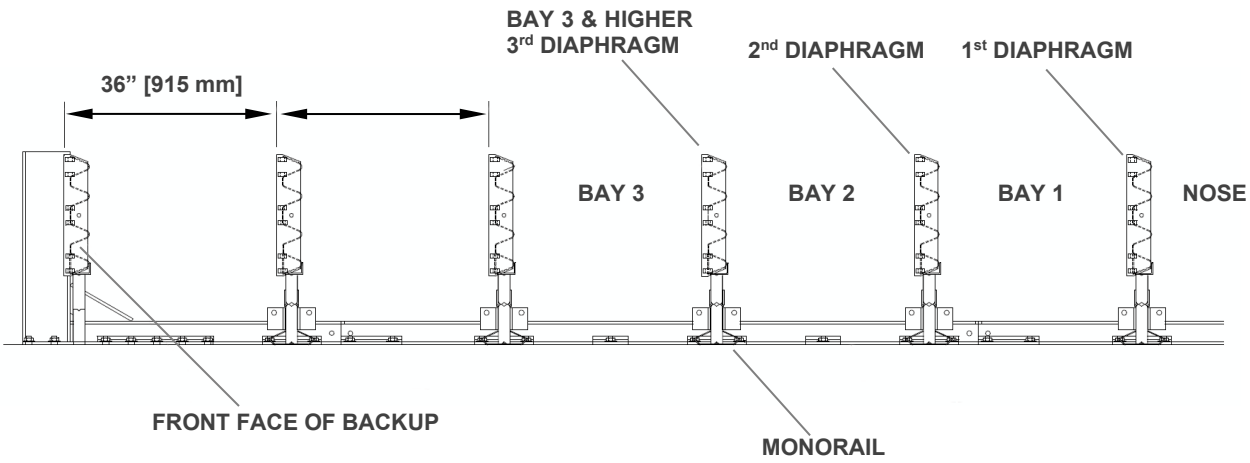


Figure 58
Diaphragm spacing

8) Attach Hinge Plate onto Fender Panels

Note: Do not mix the 5/8” rail nuts (large) with the 5/8” hex nuts (small) (Figure 59).

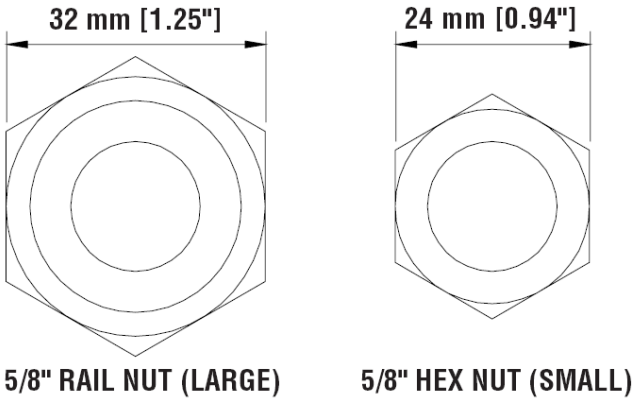


Figure 59
Rail Nuts are Oversize

Note: For proper impact performance, wide systems must use Hinge Plates.

Attach Hinge Plate on each Fender Panel using two (2) 5/8” rail bolts and two (2) 5/8” rail nuts, using top and bottom holes only, leaving the center-hole open as shown in Figure 60.

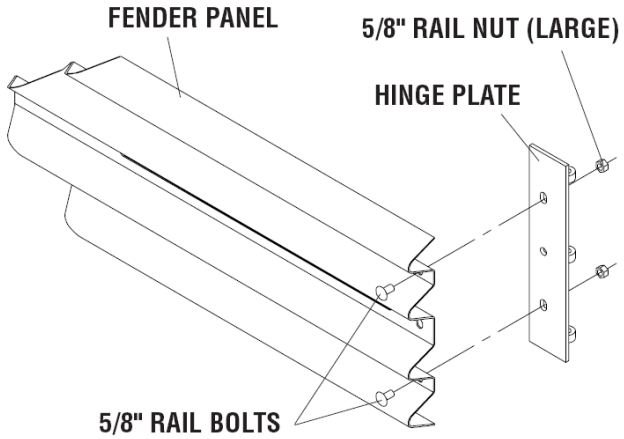


Figure 60
Hinge Plate Assembly

9) Attach Fender Panels

Starting at the Backup, attach left and right Fender Panels as shown in Figure 61 and Fender Panel Assembly drawing.

Step 1

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.

Attach Mushroom Washer Assembly as shown in Figure 61, Detail 61a and Detail 61b, but do not torque at this time (this helps to balance the Fender Panel).

Step 2

Slide the Fender Panel forward until the holes in the Fender Panel line up with the holes in the forward Diaphragm.

Step 3

Use a drift pin to align the center hole of the Fender Panel with the center hole of the Diaphragm.

Step 4

Attach the front of the Fender Panels to the next Diaphragm using two (2) rail bolts and large hex nuts per side. Use only the top and bottom holes; leave the center hole open until the next Fender Panel is attached.

Step 5

Be sure Mushroom Washer lays flat against the Fender Panel as shown in Detail 61a. Standoff on Mushroom Washer must be seated completely through slot.

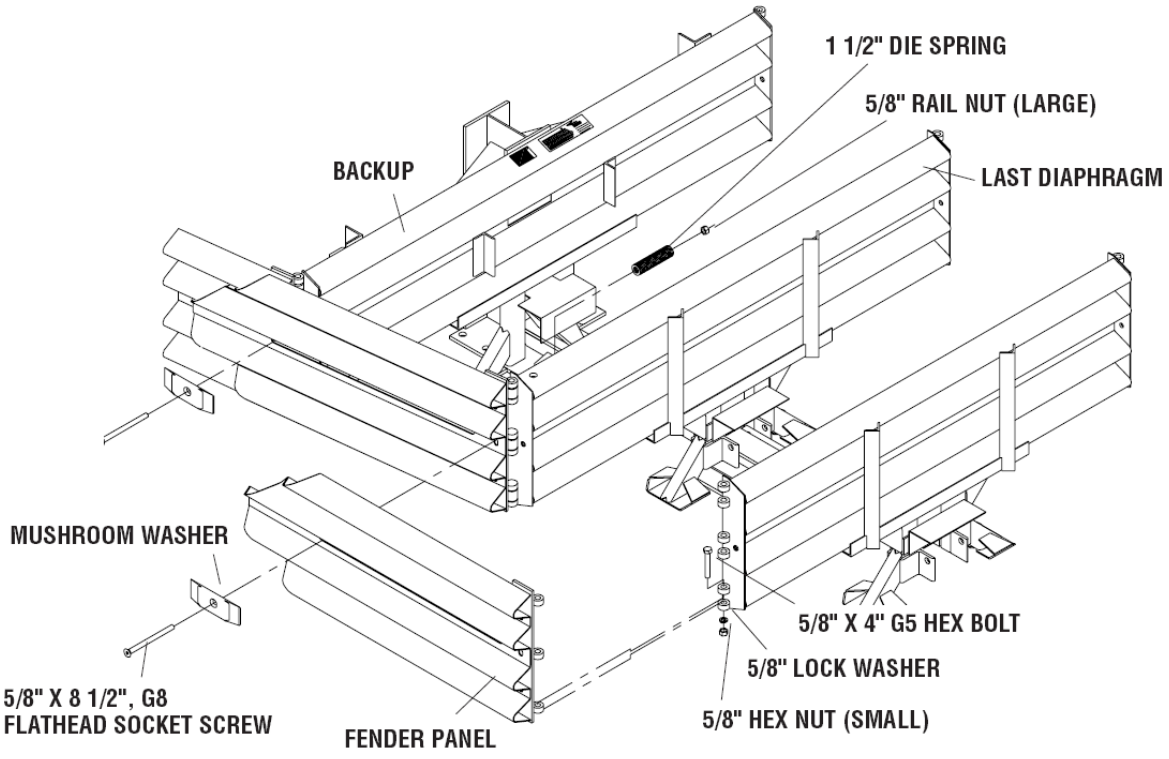
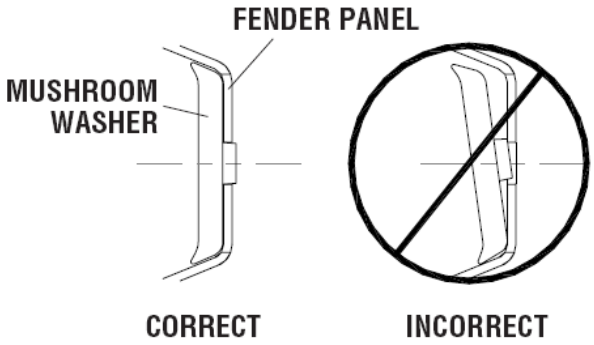
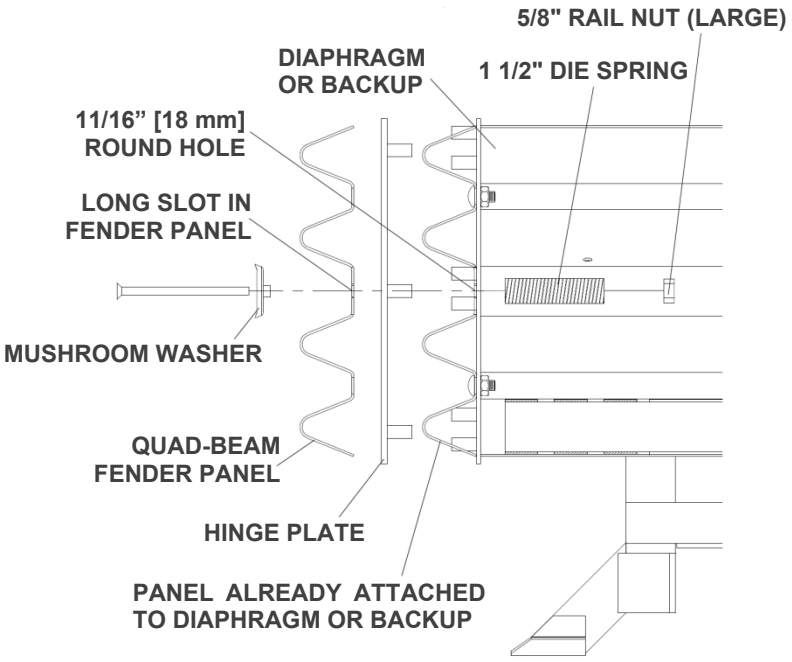


Figure 61
Fender Panel Assembly



Detail 61A
Mushroom Washer Orientation



Detail 61B
Mushroom Washer Attachment

Step 6

Check Diaphragm spacing to ensure 36” [915 mm] between rear faces of consecutive Diaphragms as shown in Figure 62 and Fender Panel Assembly drawing.

Step 7

Once the proper spacing has been achieved, torque the Mushroom Washer Assembly (small hex nut) until it reaches the end of the threads. Assemble the remaining Diaphragms and Fender Panels following the same procedures.

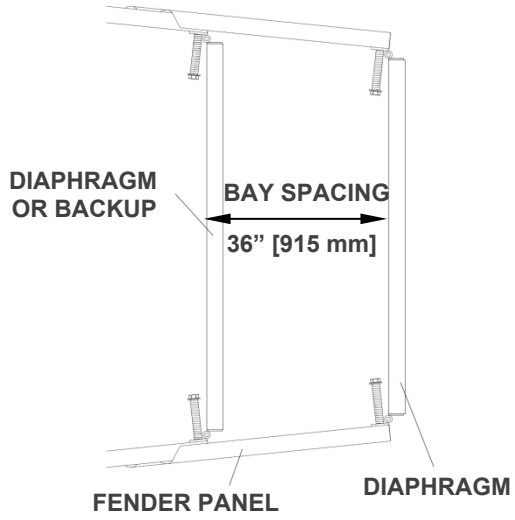


Figure 62
Proper Diaphragm Spacing

10) Attach End Cap

Using 5/8” x 3 1/2” G5 hex bolt, 5/8” hex nut and 5/8” lock washer, attach the End Cap to the front of the first Monorail segment as shown in Figure 63 and the Monorail Assembly drawing.

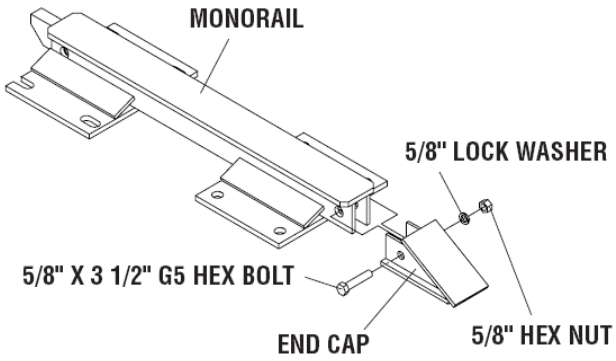


Figure 63
Monorail End Cap Assembly

11) Assemble Cartridge Support Brackets

Attach lower Cartridge Support Bracket to front and back of all Diaphragms and front of Backup as shown in Figures 64 - 67, the Backup Assembly drawing and the Diaphragm Assembly drawing.

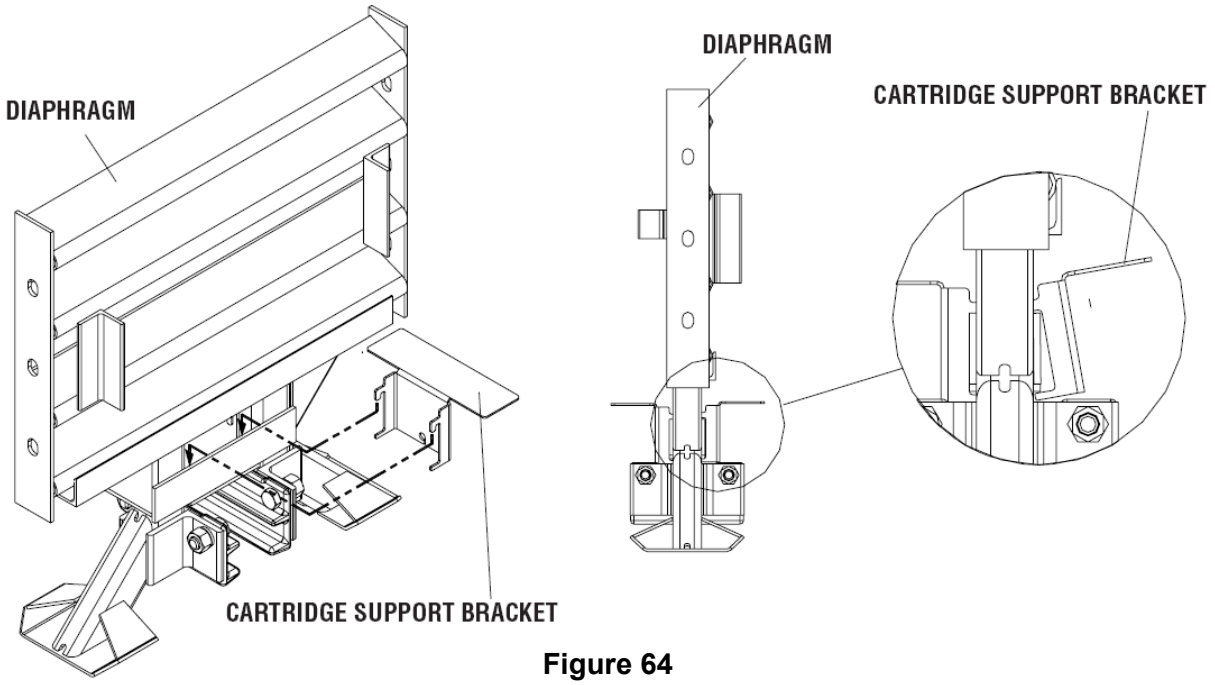


Figure 64
Diaphragm with
Cartridge Support Bracket

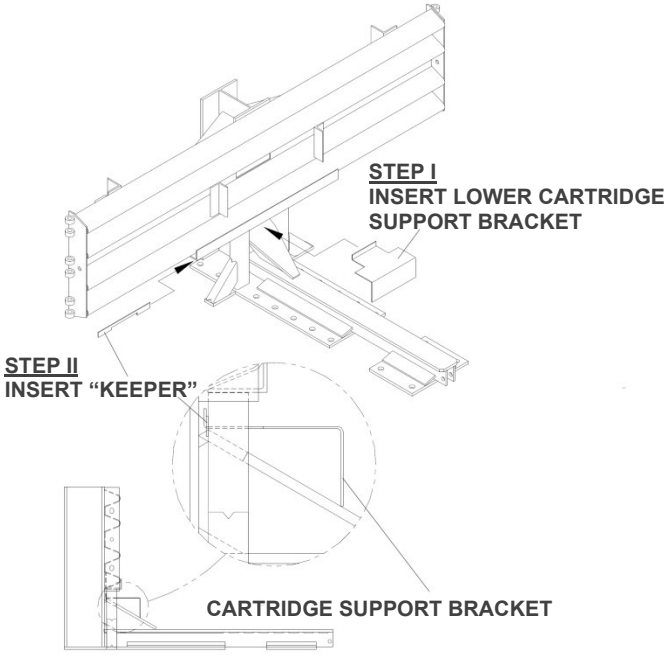


Figure 65
Cartridge Support Bracket
(Tension Strut Backup)

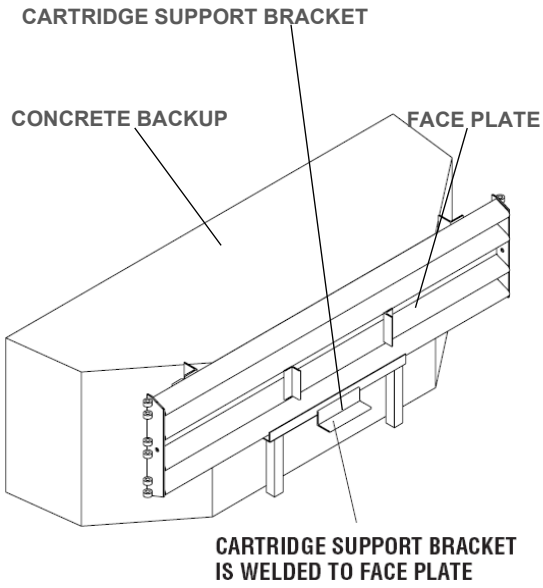


Figure 66
Cartridge Support Bracket
(Concrete Backup)

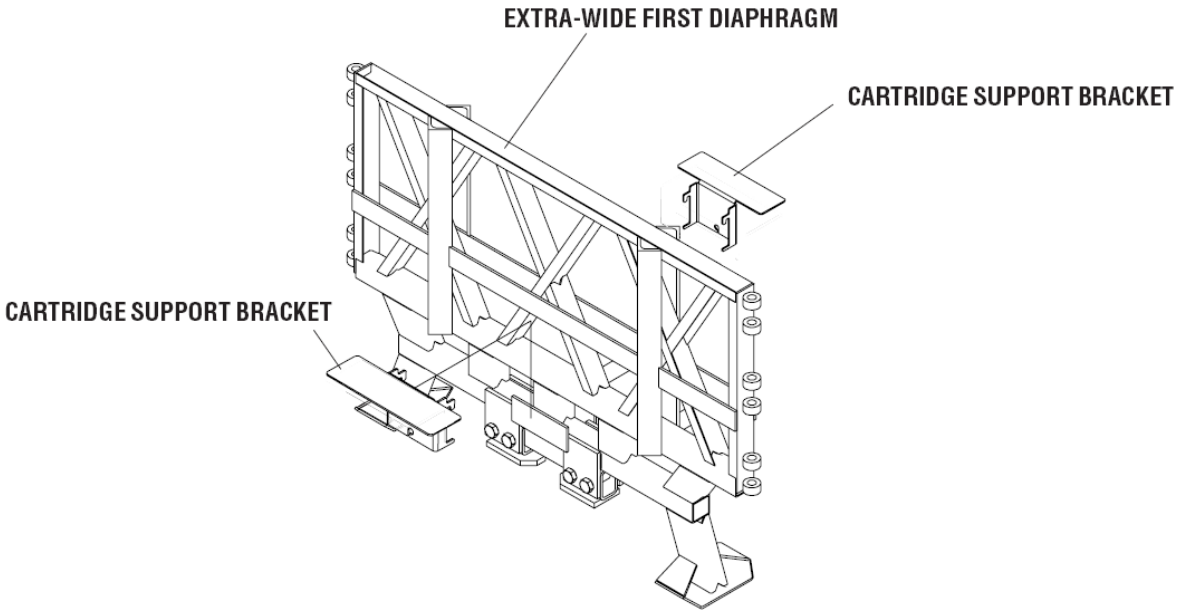


Figure 67
Extra-Wide First Diaphragm

12) Attach Nose Assembly

See pages 34 – 37 for Nose Assembly information.

13) Checking the System Assembly

At this point recheck to ensure all fasteners are properly tightened throughout the system (anchor bolts, etc.). See warning below. Check all Fender Panels. If they do not fit tightly against the underlying Fender Panels, system realignment may be necessary (Figure 68).

Warning:
Bolt Torque Requirements
Anchor Studs – p. 12 May slightly protrude above nuts
Critical Clearances
Anchor Studs above nuts – Figure 53, p. 46 Fender Panel Gap Wide – 25 mm [1.00”]

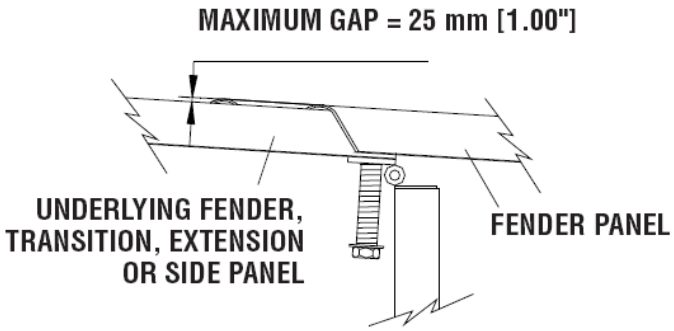


Figure 68
Fender Panel Gap for <u>Wide Systems</u>

14) Cartridge Placement

Be sure the Adjustable Cartridge Support in the Nose is attached correctly (p. 36). The top surface of the Nose Cartridge should be horizontal.

It is the responsibility of the installer to place the appropriate Cartridge in each Bay and Nose section of the QuadGuard®. Type I Cartridges are placed toward the front and Nose of the system; Type II Cartridges are placed toward the rear of the system (Figure 69).

Warning: Placing the wrong Cartridge in the Nose or any Bay is strictly prohibited pursuant to NCHRP Report 350 testing criteria. Such configurations have not been accepted for use and may result in unacceptable crash performance.

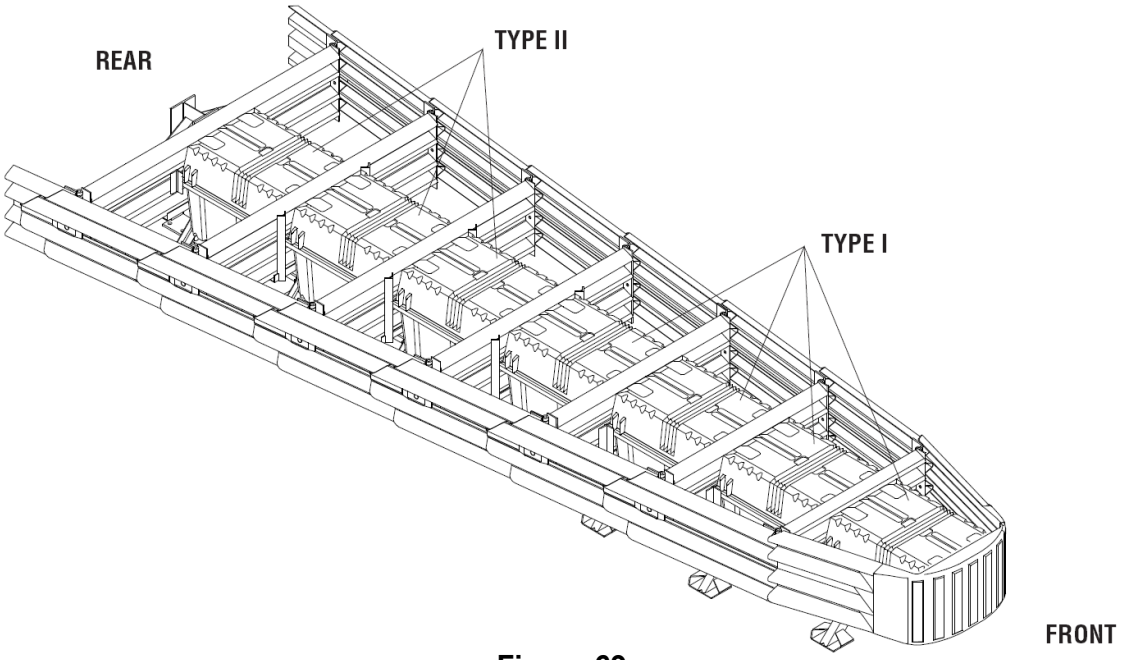


Figure 69
Typical Cartridge Layout
(Six - Bay System Shown)

I-TYPE I CARTRIDGE
II-TYPE II CARTRIDGE

Figure 70
Cartridge Placement

QuadGuard® Final Inspection Checklist

Site Location: _____

Date: _____

Inspector: _____

Refer to the QuadGuard® manual and/or drawing package.

- ☐ Clearance of 30” minimum behind rear Fender Panels for movement (p. 19)
- ☐ Proper Transition Panel is used for the type of barrier (p. 22, 42)
- ☐ Every borehole and slot in Backup and Monorail is utilized (p. 23, 24, 44, 45, 46, 47)
- ☐ Anchor stud(s) height is 1.5” or less above the pad (p. 24)
- ☐ If no transition is used, narrow side panels are used with backup (p. 26,47)
- ☐ Monorail guides are attached to the Diaphragms with shims (p. 27, 47)
- ☐ Mushroom Washer tabs lay flat within fender panel slots (p. 29, 51)
- ☐ Fender Panel nuts are bottomed out on Mushroom Washer bolt (p. 29,52)
- ☐ Monorail End Cap Assembly in place (p. 31, 53)
- ☐ Cartridges are level and the same height in each Bay (p. 35, 56)
- ☐ Nose Cartridge is level (p. 34)
- ☐ Fender Panel gap is 0.78” or less for Narrow systems (p. 37)
- ☐ Fender Panel gap is 1” or less for Wide systems (p. 55)
- ☐ Cartridge types are in properly placed in each Bay (p. 38, 56)
- ☐ Bolts and nuts are properly tightened throughout the system (p. 37, 56)
- ☐ Anchor nuts are torqued to adhesive manufacture specification (p. 12)
- ☐ System is clear of debris

Important: It is critical that you inspect this product after assembly is complete to make certain that the instructions provided in this manual have been strictly followed.

Maintenance and Repair

Inspection Frequency

Inspections are recommended as needed based upon volume of traffic and impact history. Visual Drive-By Inspections are recommended at least once a month. Walk-Up Inspections are recommended every six months for systems asphalt and once a year for concrete.

Visual Drive-By Inspection

1) Check to see if there is evidence of an impact. If so, a walk-up inspection will be necessary.
2) Check to see if the Cartridges appear to be off the Support Brackets. Any damaged Cartridges will need to be replaced.

Warning: See Cartridge placement instructions on page 38.

3) Be sure the Nose is in place.
4) Note the location and condition of the QuadGuard® and the date of visual drive-by inspection.

Walk-Up Inspection

- ☐ Clear and dispose of any debris on the site.
- ☐ Clear and remove excessive dirt from around the Monorail and Diaphragm feet.
- ☐ Bolts are tight and rust free.
- ☐ Anchor bolts are securely anchored.
- ☐ Ensure Diaphragm Legs are straight.
- ☐ All Mushroom Washer Assemblies are properly seated.
- ☐ Fender Panels and Transition Panels should nest tightly against the system.
- ☐ Be sure Cartridges have not been damaged and are properly seated on their Support Brackets. To ensure intended speed characteristics, partially crushed Cartridges (due to low speed impacts) shall be replaced.
- ☐ Make all necessary repairs as described above. See Post-Impact Instructions for more information on next page.
- ☐ To determine if a product should be replaced or is potentially reusable, a trained engineer experienced in highway products and directed by the DOT, or other appropriate local highway authority, must be consulted.

Post-Impact Instructions

Warning: If either (**wide or narrow**) system is anchored to asphalt, up to 10% of the total anchors may be replaced if damaged. If more than 10% of the anchors are damaged, the system should be relocated to fresh, undisturbed asphalt and redeployed using the 18" [460 mm] threaded rods.

Narrow or Wide System

1) Deploy the appropriate traffic-control devices for protection.
2) 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.

Caution: QuadGuard® Wide systems should **never** be anchored to asphalt.

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) Be sure that the Diaphragm Support Legs are all properly attached to the Monorail.

Caution: **Use safety goggles and gloves when refurbishing the Mushroom Spring Assembly.** Do not place fingers underneath an assembled Mushroom Washer. Parts may suddenly shift and fingers may be pinched. If the spring is still under compression as the nut is nearing the end of the bolt, to prevent injury, make sure that the spring is restrained with a clamp so it does not suddenly release when nut is removed from the Mushroom Washer Bolt.

6) Attach chain to Pullout Brackets on first Diaphragm for QuadGuard® Narrow or Wide (Figure 71). Attach both ends of chain to a heavy vehicle (such as a 1 ton pickup).

Warning: Stand clear in case chain breaks or becomes disconnected.

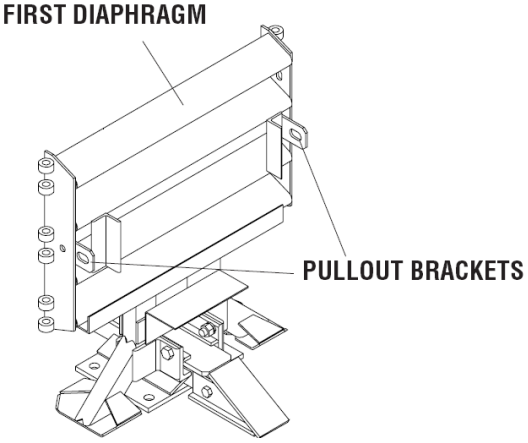


Figure 71
Pullout Brackets

Slowly pull the QuadGuard® system forward until fully restored to 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.

7) Remove all crushed Cartridges from within the system.

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

9) Check the **gaps between Fender Panels**. The maximum gap allowed for these overlapping parts (including Fender Panels overlapping Panels behind the system) is .78" [20 mm] for **narrow systems** and 1.00" [25 mm] for **wide systems**. Be sure the Mushroom Washer Assemblies are torqued to the end of the threads. If the gaps between the Fender Panels are still too large, it may be necessary to replace bent parts.

Warning:	
Fender Panel	Maximum gap allowed:
Narrow Systems	**0.78" [20 mm]**
Wide Systems	**1.00" [25 mm]**

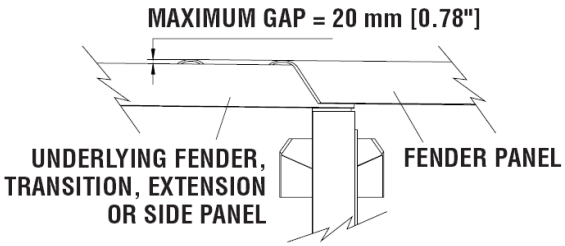


Figure 72
Narrow Systems Fender Panel Gap

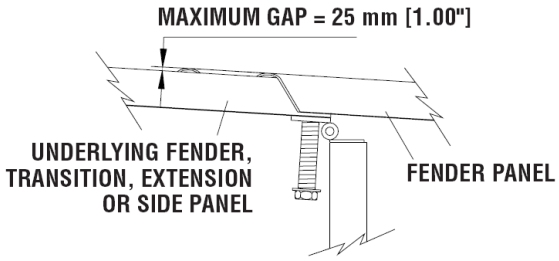


Figure 73
Wide Systems Fender Panel Gap

10) Replace all crushed Cartridges (p. 38 & 56).

11) Remove damaged Nose Assembly. Attach the new Nose to the first Diaphragm using the six (6) rail bolts, coupling nuts, rail nuts, cap screws, Pull-Out Brackets, and Bar Washers that hold the Nose to the first Diaphragm. Adjust Nose to align with Fender Panels and then tighten all six (6) nuts.

Warning:
Bolt Torque Requirements - p. 12
Critical Clearances
Anchor Studs above nuts – Figure 20, p. 24 **Fender Panel Gap Narrow – 0.78" [20 mm]** **Fender Panel Gap Wide – 1.00" [25 mm]**

12) Confirm the torque of all bolts on the system (p. 12).

13) Check to be certain that the site is free from any debris.

14) The QuadGuard® is now ready for use.

Parts Ordering Procedure

Make a list of all damaged parts using part descriptions shown on page 63 and 64 of the system images. Answer the following questions in the spaces provided. This information is necessary to receive the proper parts.

QuadGuard® System Ordering Information Chart		
Description:	**Choices**	**Fill in this section**
What is the system width? (p. 17)	24” [610 mm] 30” [760 mm] 36” [915 mm] 48” [1219 mm] 69” [1755 mm] 90” [2285 mm] 126” [3200 mm]	
How many Bays (p. 16)?	Narrow systems: 1 through 6 Wide systems: 3 through 6	
What type of Backup does the system have (p. 20)?	Concrete Tension Strut	
What type of Transition Panel is required? Side Panel and Transition Panel Types (p. 21) Note right side, left side, or both sides (p. 16)	• Quad to W • Quad to Thrie • Quad to Safety Shape Barrier • Quad to End Shoe • 4” Offset Panel	

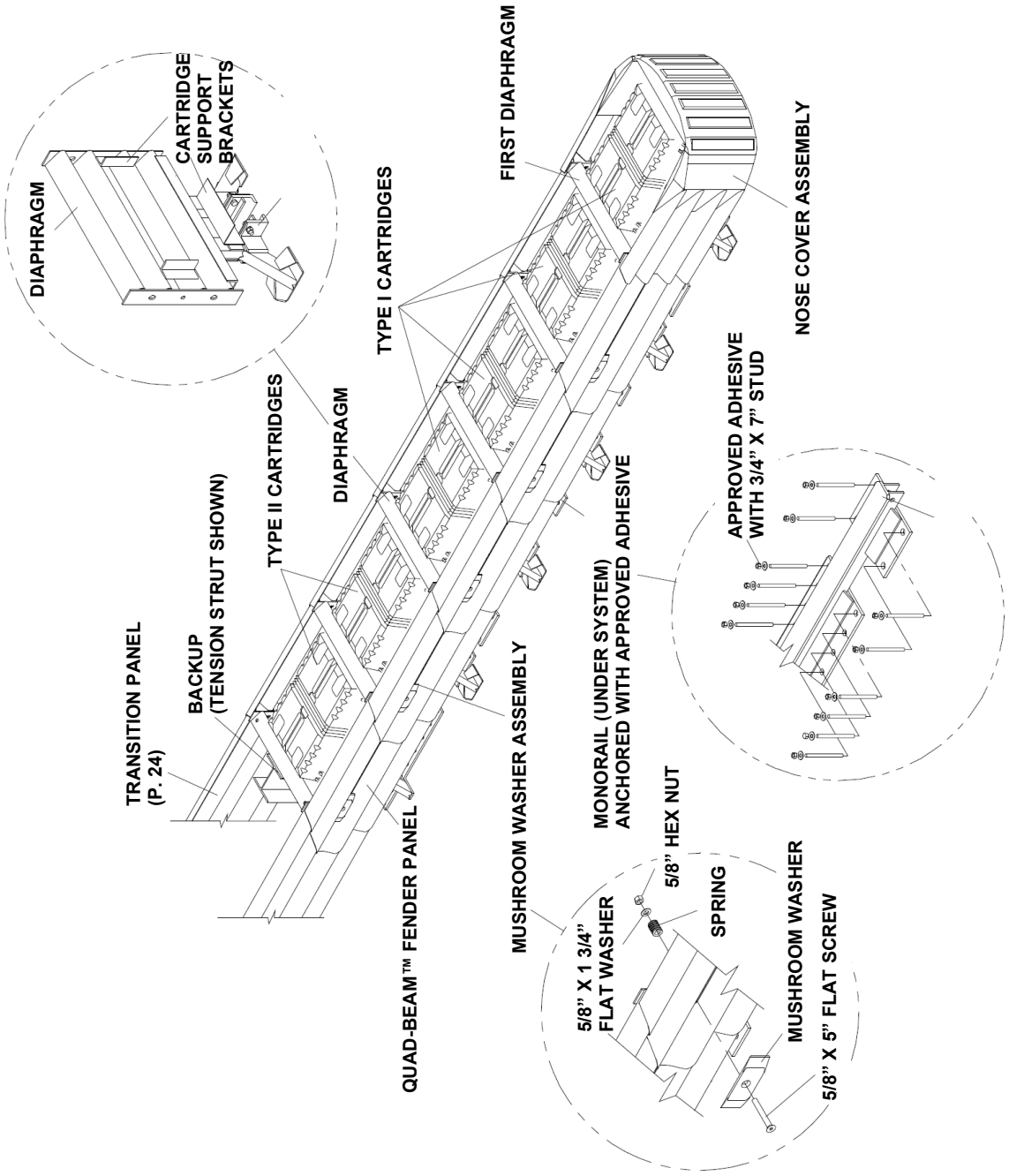


Figure 74
QuadGuard® Narrow (Parallel)

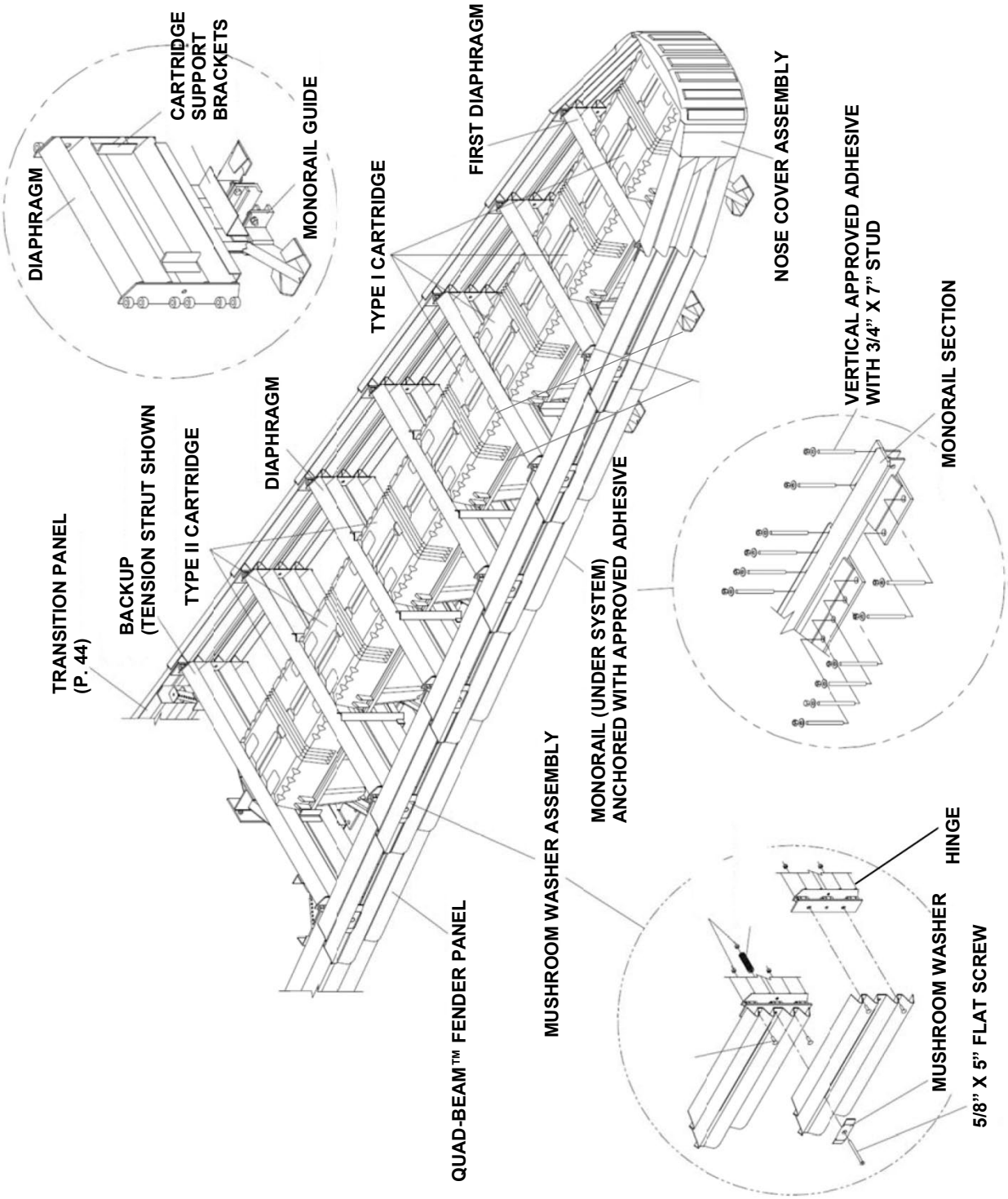


Figure 75
QuadGuard® Wide

Notes:

Notes:

Notes:

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