VALTIR

QuadGuard® HS

CRASH CUSHIONS

ASSEMBLY MANUAL

PN 115310

REVISION D NOVEMBER 2022

QuadGuard® HS

The QuadGuard® HS system has been tested pursuant to National Cooperative Highway Research Program ("NCHRP") Report 350 specifications. The QuadGuard® HS 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® HS. Failure to fulfill these RESPONSIBILITIES with respect to the assembly, maintenance, and repair of the QuadGuard® HS could result in serious injury or death.

Important: 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/Products/.

The information contained in this manual supersede all previous versions. The instructions, illustrations, and specifications are based on the latest QuadGuard® HS information available to Valtir at publication. We reserve the right to make changes at any time. Please visit Valtir.com/Product/QuadGuard-HS/ to confirm the latest revision.

Part No. 115310

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Customer Service Contacts

Valtir is committed to the highest level of customer service. Feedback regarding the QuadGuard® HS system, 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)
Contact Link	Valtir.com

Important Introductory Notes

Proper assembly of the QuadGuard® HS 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® HS. These instructions are to be used in conjunction with the assembly of QuadGuard® HS and are for standard assemblies only as specified by the applicable highway authority. If additional information is needed about the QuadGuard® HS, 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® HS 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 above. 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® HS 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® HS. 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® HS system. Additional copies of this manual are available from Valtir by calling (888) 323-6374 or visiting Valtir.com/Product/QuadGuard-HS/. Please contact Valtir if you have any questions concerning the information in this manual or about the QuadGuard® HS.

Always use appropriate safety precautions when operating power equipment, mixing chemicals, and when moving heavy equipment or QuadGuard® HS components. Safety articles including but not necessarily limited to work gloves, eye/ear protection, safety-toe shoes, silica dust management systems, 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 must be used to protect all personnel while at the assembly, maintenance, or repair site.

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

Limitations and Warnings

Valtir, in compliance with NCHRP Report 350, contracts with FHWA approved testing facilities to perform crash tests, evaluation of tests, and submit results to the FHWA for review.

The QuadGuard® HS system has been deemed eligible for reimbursement by FHWA as meeting the requirements and guidelines of NCHRP Report 350 TL-3 Plus with an increase speed from 62 mph [100 km/h] to 70 mph [113 km/h]. These tests typically evaluate product performance by conducting testing pursuant to parameters set forth in NCHRP Report 350 and accepted by FHWA which include a range of vehicles from lightweight cars (approx. 1800 lb. [820kg]) to full size pickup trucks (approx. 4400 lb. [2000 kg]) as specified by the FHWA. A product can be certified for multiple Test Levels. The QuadGuard® HS is certified to the Test Level(s) as shown below:

Test Level 3 Plus: 70 mph [113 km/h]

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® HS 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. Careful evaluation of the site lay out, vehicle population type; speed, traffic direction, and visibility are some of the 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.

Warning: Do not assemble, maintain, or repair the QuadGuard® HS until you have read this manual thoroughly and completely understand it. Ensure that all Danger, Warning, Caution, and Important statements within the manual are completely followed. Please call Valtir at (888) 323-6374 if you do not understand these instructions.

Warning: Ensure that all of the QuadGuard® HS Danger, Warning, Caution, and Important statements within the QuadGuard® HS manual are completely followed. Failure to follow this warning could result in serious injury or death in the event of a collision.

System Overview

The QuadGuard® HS, through crash testing, has been shown to be a potentially reusable, re-directive, non-gating crash cushion, within NCHRP Report 350 criteria, for hazards ranging in width from 24” to 90” [610 mm to 2285 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® HS system utilizes two types of cartridges in a “staged” configuration and empty Bays to address both lighter cars and heavier, high center-of-gravity vehicles.

Impact Performance

The 9 Bay QuadGuard® HS 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 70 mph [113 km/h] at angles up to 20 degrees.

During head-on impacts, within NCHRP Report 350 criteria, the QuadGuard® HS has been shown that it compresses rearward and crushes to absorb the energy of impact. When impacted from the side, it safely redirects the vehicle back toward its original travel path and away from the hazard.

Inspect Shipping

Before deploying the QuadGuard® HS, check the received parts against the shipping list supplied with the system to ensure all parts are included.

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

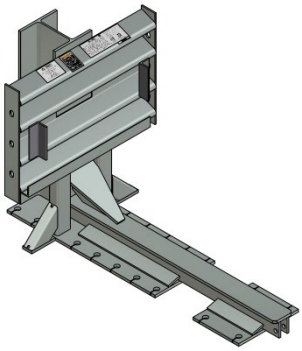
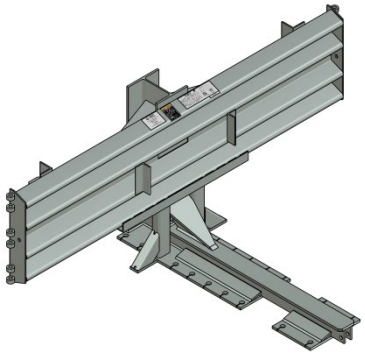
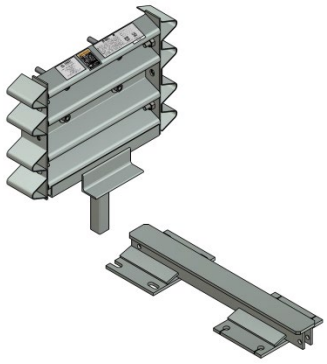
Warning: Do NOT modify the QuadGuard® HS in any way.

System Components

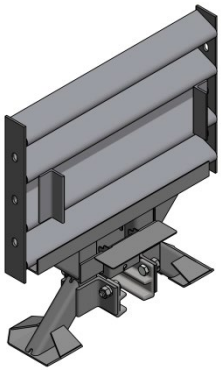
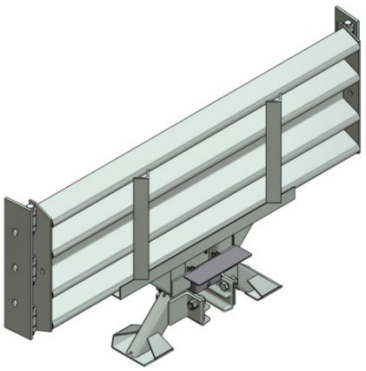
Below is a list of system components to be used in the repair of your particular QuadGuard® HS configuration. Please call Valtir customer support if you have any questions (p. 3).

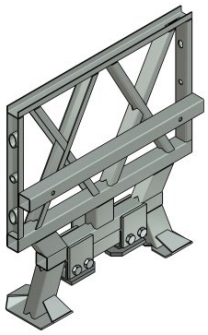
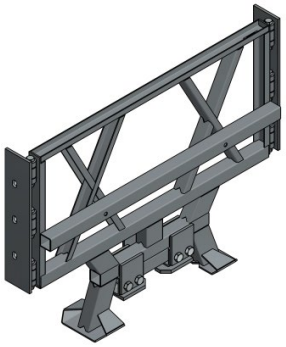
Warning: Use only Valtir parts that are specified herein for the QuadGuard® HS for assembling, maintaining, or repairing the QuadGuard® HS. **Do not utilize or otherwise comingle parts from other systems even if those systems are other Valtir systems.** Such configurations have not been tested, nor have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

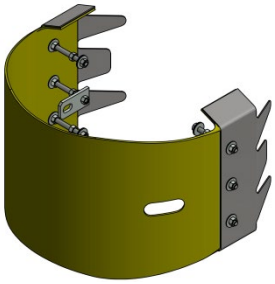
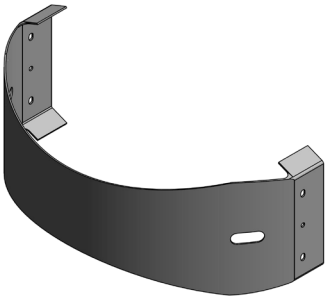
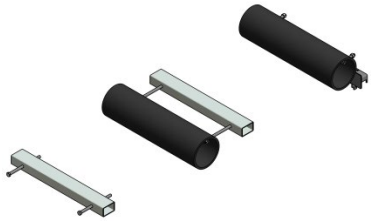
Note: Components are not shown to scale.

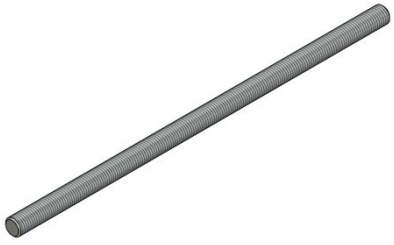
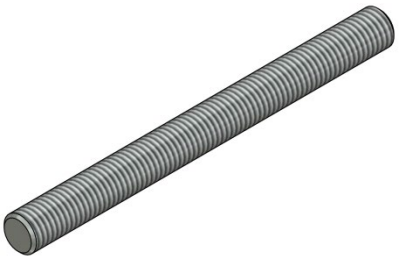
Backup, Narrow Tension Strut	Backup, Wide Tension Strut	Backup, Narrow Concrete
		
* 604741 - 24” * 604748 - 30” * 604762 - 36”	* 604785 – 69” * 604789 – 90”	* 604507 – 24” * 604508 – 30” * 604509 – 36”

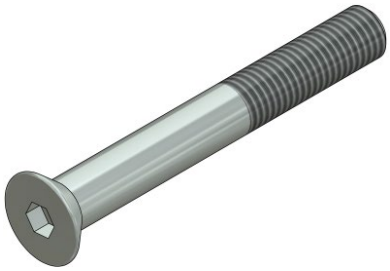
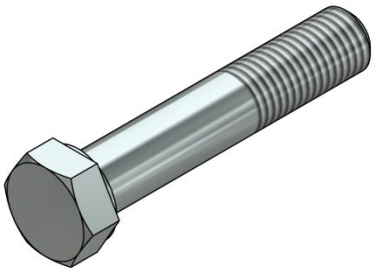
* Assembly

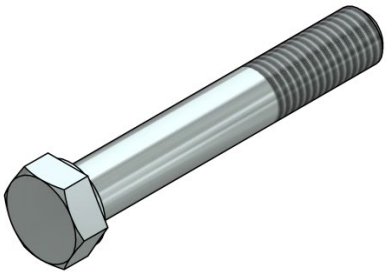
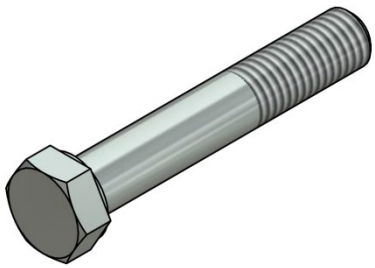
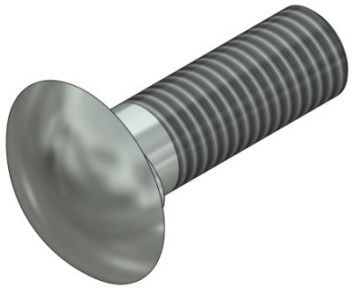
Narrow Diaphragm Assemblies	Wide Diaphragm Assemblies		
			
625650 - 24” 625651 - 30” 625652 - 36”	607146 – 45.38” 607148 – 48.53” 607150 – 51.68”	607151 – 54.83” 607152 – 57.98” 607157 – 61.13”	607158 – 64.28” 607160 – 70.58” 607163 – 76.88”

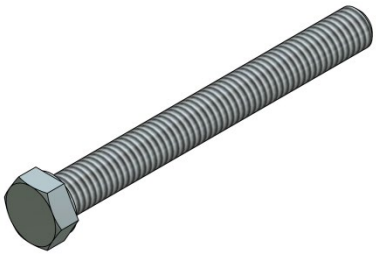
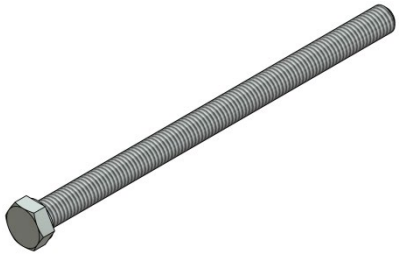
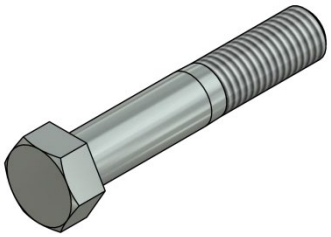
QG HS Diaphragm Assembly Narrow	QG HS Diaphragm Assembly Wide	
		
606793 – 24” 606794 – 30” 606795 – 36”	**QG HS 69”**	**QG HS 90”**
	607121 – 35.88” 607122 – 39” 607123 – 42.25”	607119 – 26.5” 607120 – 32.75” 607122 – 39”

Belt Nose Assembly Narrow	Belt Nose Assembly Wide	Bumper Assembly
		
611502 – 24” or 30” Gray 611503 – 24” or 30” Yellow 611504 – 36” Gray 611505 – 36” Yellow	611500 – Gray 611501 - Yellow	605696 – 24” 605697 – 30” 605698 – 36” 605699 – 69” 605700 – 90”

Stud, 3/4x7”, G5	Stud, 3/4x18”, G5	Stud, 5/8x7”, G5
		
117542	116799	116810

Screw, Flat, 5/8X8 1/2" Wide	Screw, Flat, 5/8X5”,G8, Narrow	Bolt, Hex, 3/4”X4”, G5, G
		
116879	116878	113567

Bolt, Hex, 5/8”X4”, G5	Bolt, Hex, 1/2”X3”, G2, G	Bolt, Rail, 5/8X2”
		
113666	113476	003400

Bolt, Hex, 3/8”X3 1/2”, G2	Bolt, Hex, 1/2”X8”, G2	Bolt, Hex, 5/8” x 3 1/2”, G5
		
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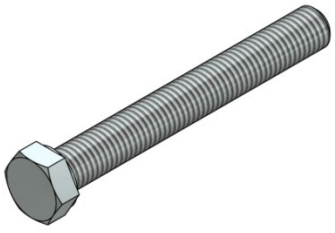
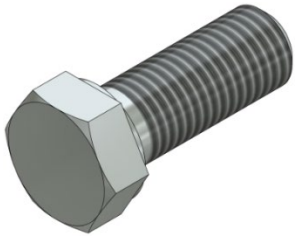
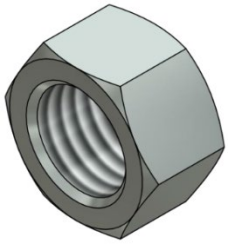
Bolt, Hex, 5/8X5”, G5	Bolt, Hex, 3/4”X2”, G8	Nut, Hex 1/2”, G
		
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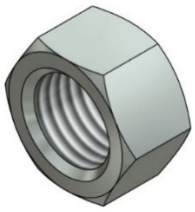
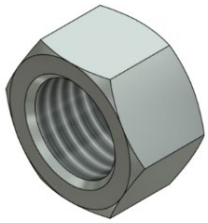
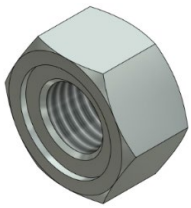
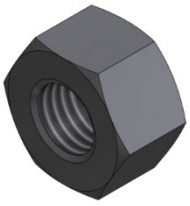
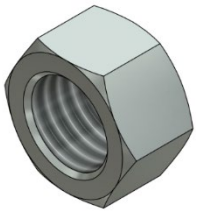
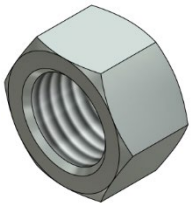
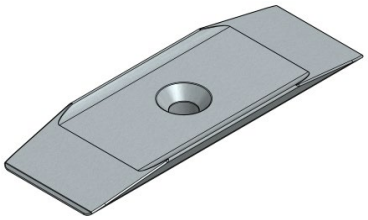
Nut, Hex 3/4”	Nut, Heavy Hex, 5/8”	Nut, Rail, Hex, 5/8”
		
003710	003354	003340

Nut, Heavy Hex, 3/4"	Nut, Hex, 3/8”X1”	Nut, Hex, 5/8”
		
003704	115960	115970

Washer, Flat 1/2”X1 3/8”	Washer, Lock, 5/8”	Washer, Lock, 3/8”
		
118009	118100	118092

Washer, Flat, 5/8” X 1 3/4"	Washer, Flat, 3/4"	Washer, Lock, 3/4"
		
003300	118027	118089

Mushroom Washer	Spring, 6”, Wide	Spring, 1 1/2”, Narrow
		
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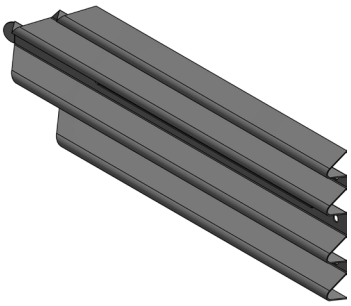
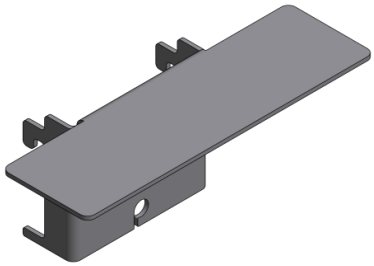
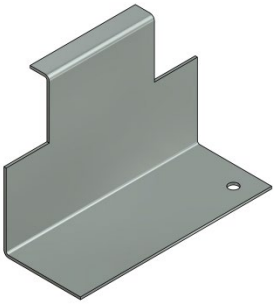
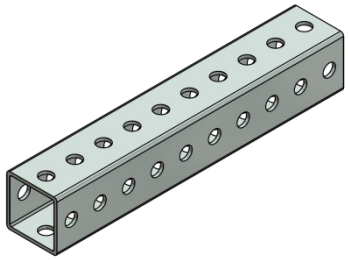
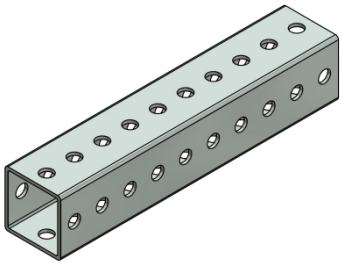
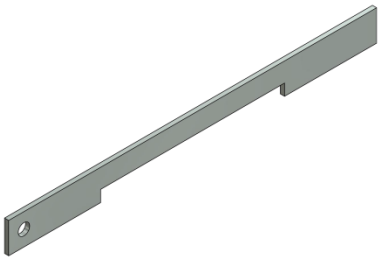
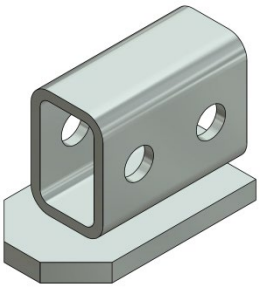
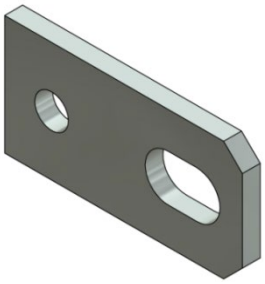
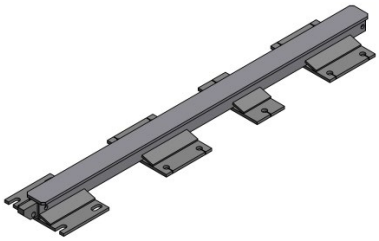
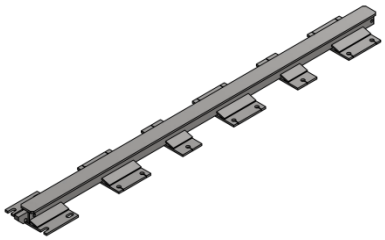
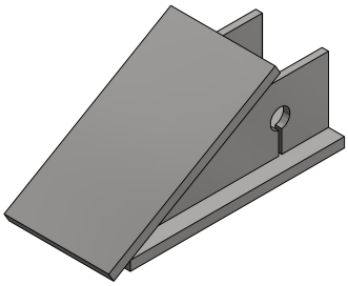
Panel, Side, QG Narrow	Panel, Fender, QG	Clamp, Belt, LMC
		
611898	611832	606330

Bracket, Cartridge Support	Bracket, Cartridge Support TS B/U	Hinge Plate, Fender Panel
		
605446	605447	610172

Tel 1 3/4X1 3/4X12GA, G, 10”	Tel 2X2X12GA, H2S, G, 10”	Locking Bar, Cartridge Support
		
615756	615765	611266

Rail Guide, QG HS, G	Monorail Guide	Bracket, Pull-Out
		
613506	611368	605535

Approved Adhesive	Monorail, Two Bays, QG, G	Monorail, Three Bays, QG, G
		
118710	611375	611379

End Cap, Monorail, QG, G	Cartridge Assy, Type I	Cartridge Assy, Type II
		
608136	606027	606029

Foundation/Anchoring

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

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.

Asphalt Installations

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 3" [76 mm] layer of asphalt over a minimum of 3" [76 mm] layer of **Portland Cement Concrete ("P.C.C.")**, 6" [152 mm] layer of asphalt over 6" [152 mm] layer of subbase, or 8" [203 mm] layer of asphalt with no subbase.

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

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

Foundation D: Asphalt Only

Foundation: 8” [200 mm] minimum A.C.

Anchorage: Approved adhesive with 18” [460 mm] studs - 16 1/2” [420 mm] 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 6 months. See Post Impact Instructions and Maintenance and Repair instructions on page 54.

Foundation A: Concrete Pad or Roadway

Foundation: 150 mm [6”] minimum depth Portland Cement Concrete (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 asphalt concrete (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 Specifications

For Foundations A, B, C and D mentioned above:

A. C. (Asphalt Concrete)

AR-4000 A. C. (per ASTM D3381 '83) 3/4” Maximum, Medium (Type A or B) aggregate

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

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 studs that anchor the QuadGuard® HS system 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 drilling and anchoring studs.

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 your kit. Check to ensure each borehole is drilled to the proper depth and aligned with the part to be anchored per chart 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 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.

4) Apply Approved Adhesive

Fill the borehole 100% full with adhesive material.

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 down through the part to be anchored and into the borehole. Give the stud several twists in the approved adhesive to wet the threads.

Caution: Do not disturb or load the stud until the approved adhesive material has hardened (refer to instructions supplied with the approved adhesive kit).

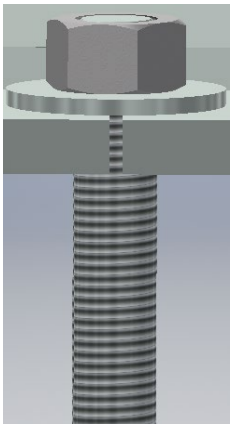


Figure 1
Vertical Application
(Before Applied Torque)

7) Torque the Nuts

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

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 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 (Figure 1 & 2)**.

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).

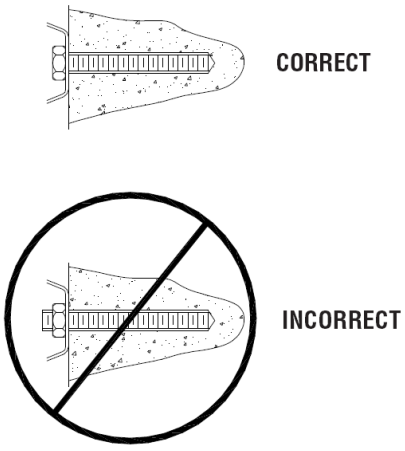


Figure 2
Horizontal Application
(Before Applied Torque)

Caution: Do not disturb or load the stud until the approved adhesive material has hardened (refer to 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/Ear Protection
- Gloves
- Safety Toe Shoes
- Protective Clothing

Cutting equipment

- Rotary hammer drill
- Rebar cutting bit
- Concrete drill bits – 7/8" [22 mm] **(Double Fluted)**
- Grinder, Hacksaw or Torch (optional)
- Drill
- 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.14).

Hammers

- Sledgehammer
- Standard hammer

Wrenches

- Heavy Duty 1/2" drive impact wrench
- 1/2" drive Sockets: 9/16", 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
- Box End Wrenches: 9/16", 3/4", 15/16", 1 1/8", 1 1/4"
- Crescent Wrench: 12" [300 mm]
- 3/8" Hex Key Wrench

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 bristle tube brush for cleaning 7/8” drilled holes
- Rags, water, and solvent for touch-up

Note: The above list of tools is a general recommendation. Depending on specific site conditions and the complexity of the assembly specified by the appropriate highway authority, additional or fewer tools may be required. Decisions as to what tools are 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 site.

How to Determine Left/Right

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

Description of a Bay

One Bay consists of one Diaphragm, two Fender Panels, etc. (Figure 3).

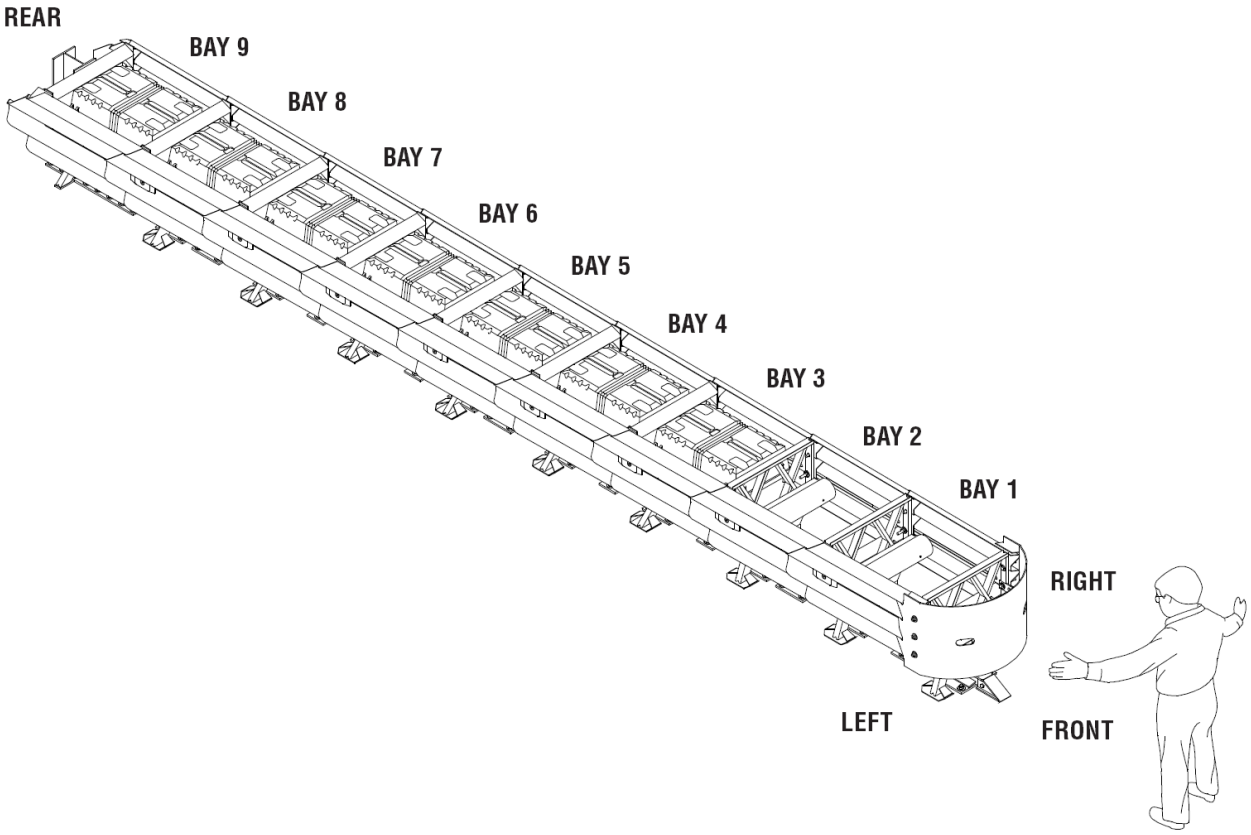


Figure 3
9-Bay System Orientation

Measuring the Width

The QuadGuard® HS system is available in five nominal widths:

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

The nominal width of a system is the width between Side Panels attached to the Backup (Figures 4 and 5). The outside system width is approximately 6” [150 mm] wider than this measurement.

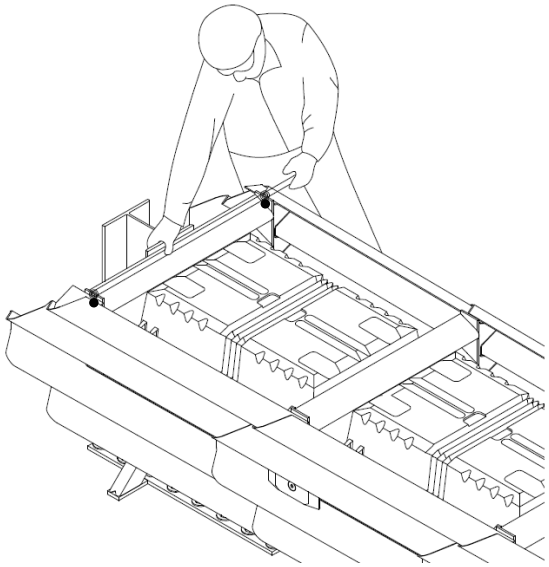


Figure 4
Measuring Tension Strut Backup Width

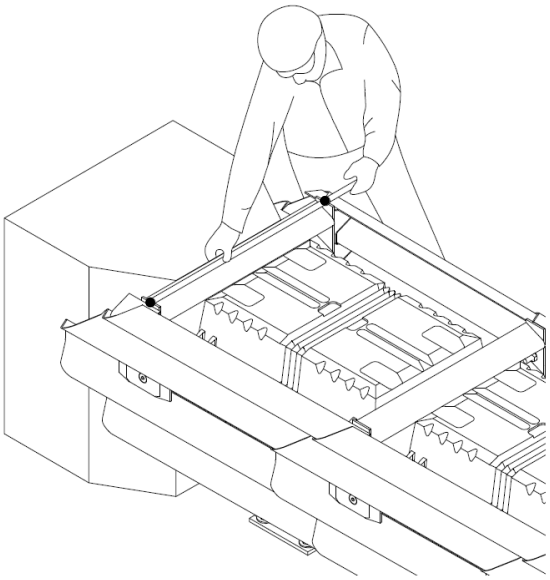


Figure 5
Width of system with Concrete Backup

Site Preparation/Foundation

A QuadGuard® HS system 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 pads are provided in Valtir Concrete Pad drawing, supplied with the system. The QuadGuard® HS system may also be assembled on a concrete roadway (minimum 8" [200 mm] thick) measuring at least 12' [3.6 m] wide by 50' [15.24 m] long. Deployment cross-slope shall not exceed 8% (Figure 6) and should not 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.

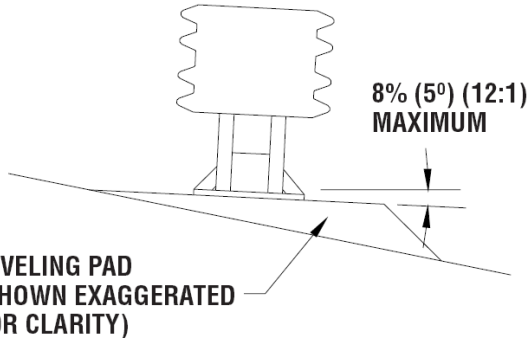


Figure 6
Cross-Slope

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] from their pre-impact location. 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 Panels. Failure to comply with this requirement is likely to result in system performance which had not been crash tested pursuant to NCHRP Report 350 criteria and may also cause component damage which will necessitate maintenance or replacement of the system.

Inspect Shipping

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

Determine Backup and Transition Type

Note: The drawing package supplied with the QuadGuard® HS must be used with these instructions for proper assembly and should take precedence over these general instructions.

Determine Backup and Transition Type

The QuadGuard® HS is available with a Tension Strut Backup or a Concrete Backup. Refer to Figures 7 and 8, along with the Backup Assembly drawing, to determine which type of Backup is assembled.

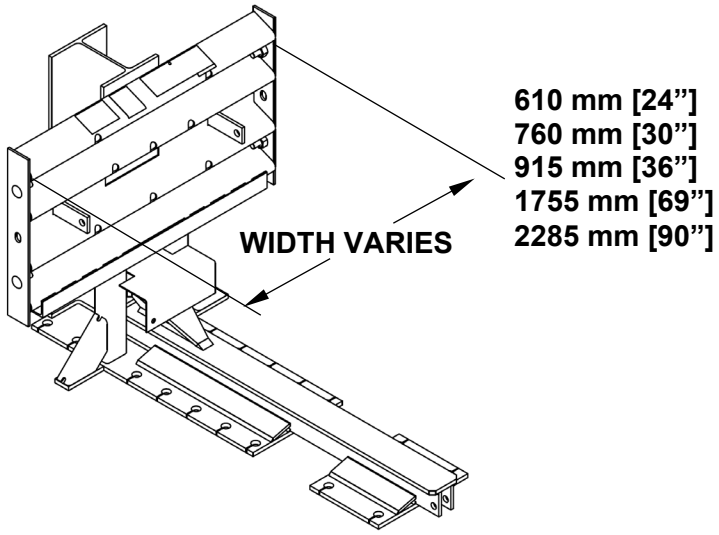


Figure 7
Tension Strut Backup

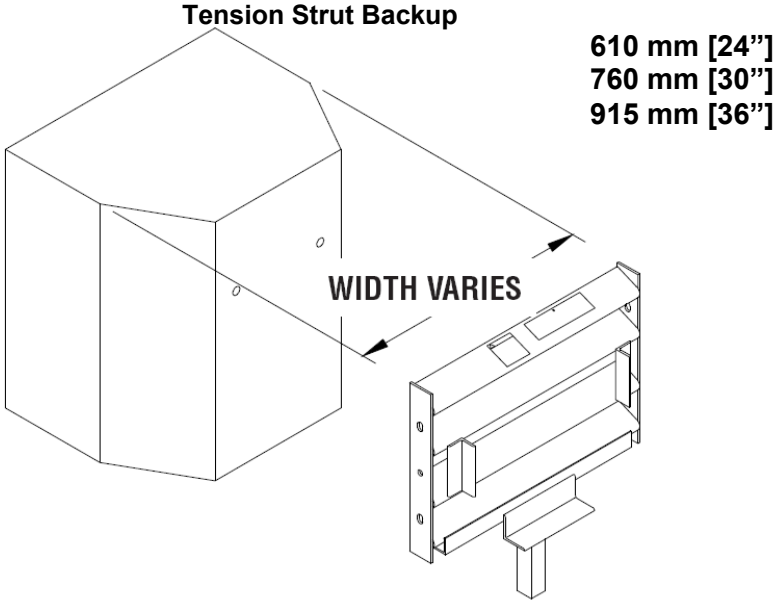
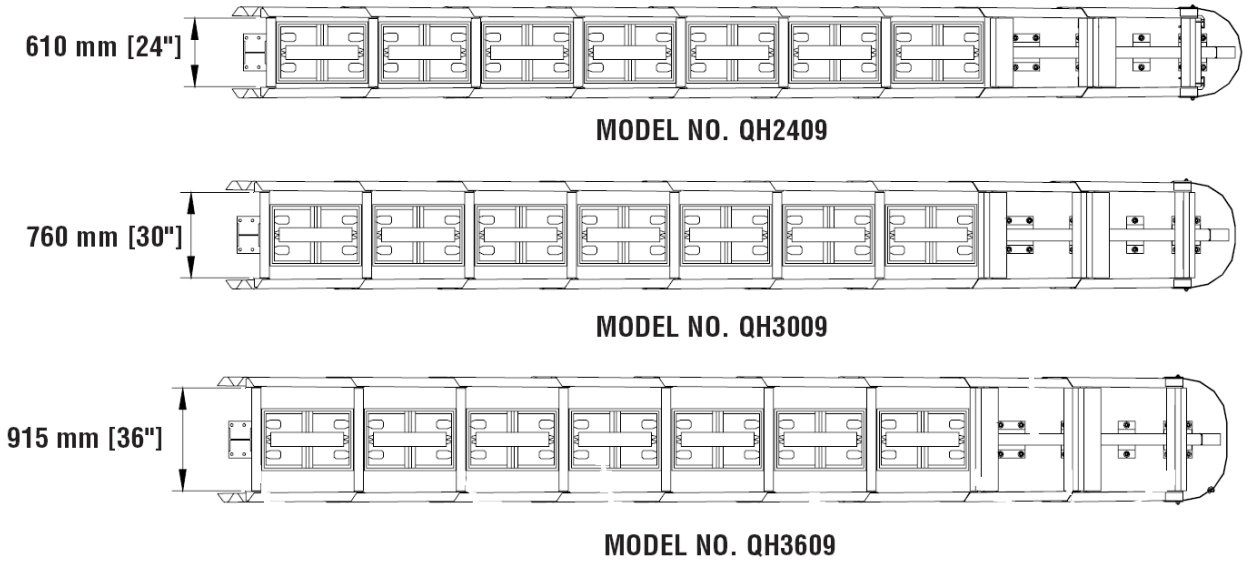


Figure 8
Concrete Backup

QuadGuard® HS Narrow



Narrow Transitions

A Transition Panel or Side Panel will be used on each side of the Backup (Figure 9). A Side Panel is not needed when a Transition Panel is used. Several types of transitions are available for use with the QuadGuard® HS. Refer to Figures 10 through 14 and the drawing package to determine which types of panels are being attached.

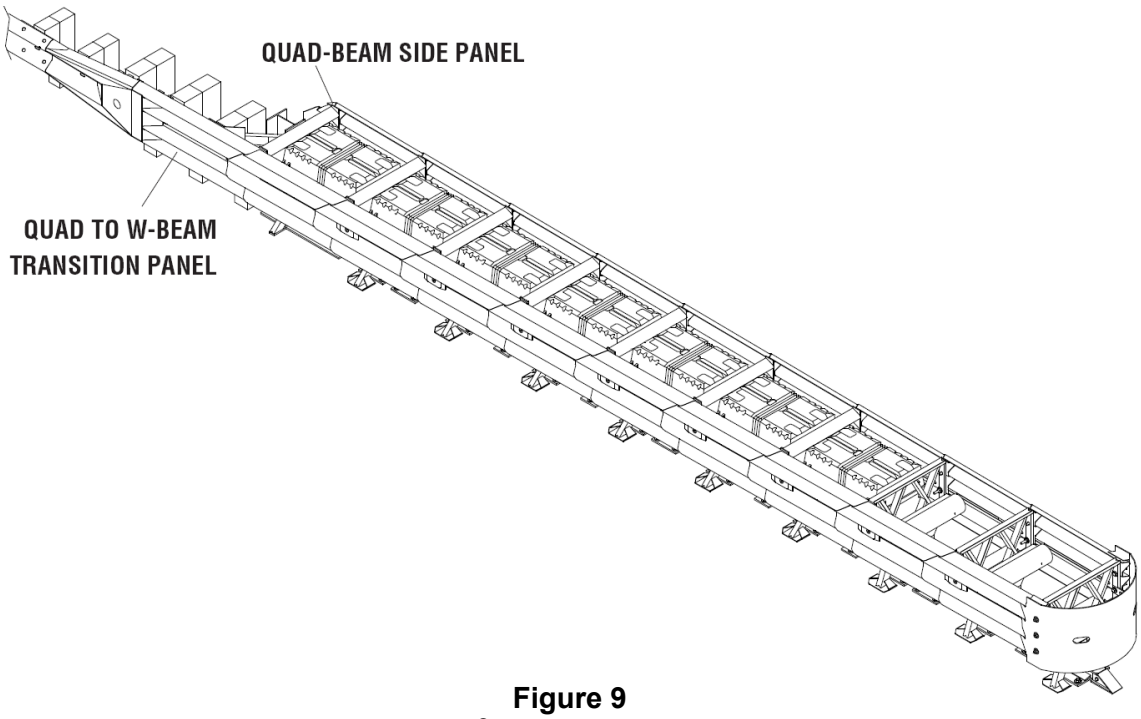


Figure 9
QuadGuard® HS with Transition Panel

Figure 10
Side Panel

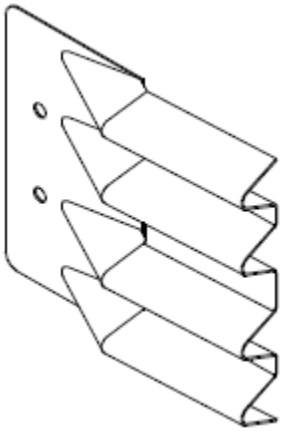


Figure 11
Quad-Beam™ End Shoe

Note: The proper Transition or Side Panel must be used for optimum 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® HS is shielding. Contact the Customer Service Department prior to assembly if you have any questions (p. 3).

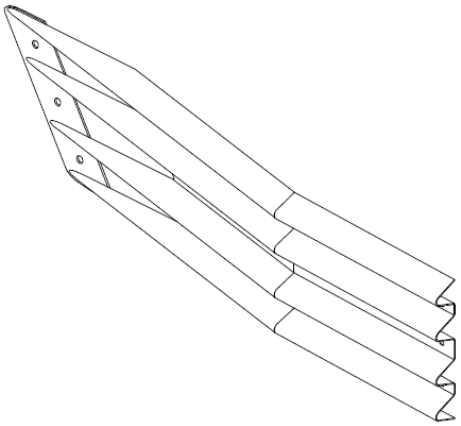


Figure 12
Safety Shape Barrier Transition Panel

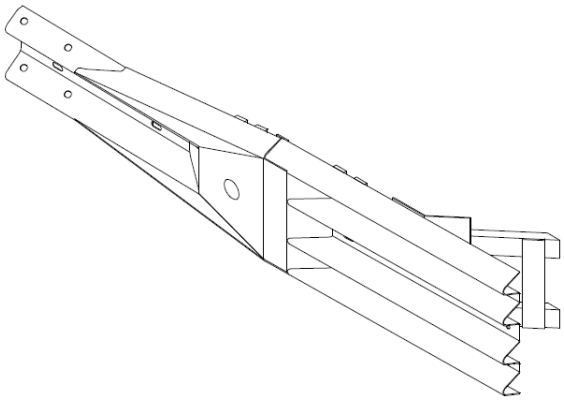


Figure 13
W-Beam Transition Panel

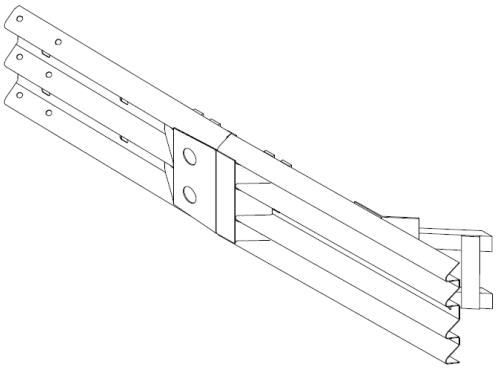


Figure 14
Thrie-Beam Transition Panel

Assembly Narrow

1) Mark System Location

Locate the centerline of the system by measuring the proper offset from the hazard. Refer to the drawing package supplied with the system. Place chalk line to mark the centerline of the system. Mark a construction line parallel to the centerline and offset 6.5” [165 mm] to one side (Figure 15). The edge of the Monorail will be place on this line.

Note: The concrete pad should be deployed per the project plans supplied with the system.

Caution: Location of the QuadGuard® HS with respect to the hazard is critical and dependent on the type on Transition Panel used. See the project plans supplied with your system for details.

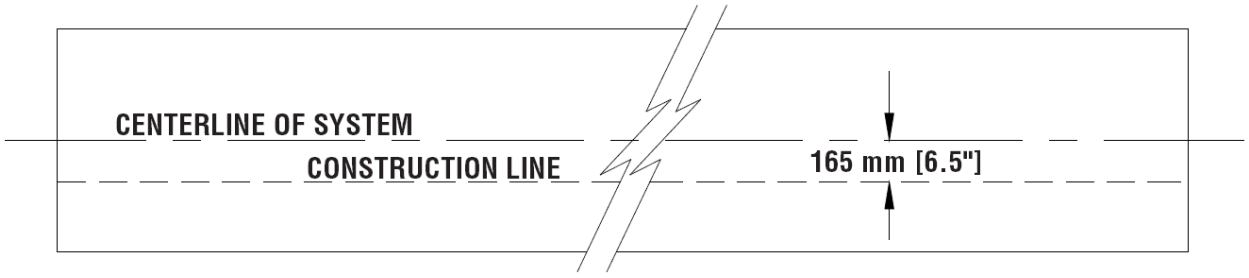


Figure 15
(Top view of concrete pad)
Locating Construction Line

2) Anchor the Backup and Monorail

Refer to Figure 16 (showing concrete Backup Assembly) or Figure 17 (showing Tension Strut Backup Assembly) and Figure 18 (showing Monorail assembly). See drawing package.

A. For Concrete Backup Assembly (Figure 17)

Locate front face plate using the Backup Assembly drawing. 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 anchoring system provided (p. 13).

B. For Tension Strut Backup Assembly (Figure 18)

Locate Tension Strut Backup and Monorail on pad with side of Monorail on the construction line (Figure 16). Verify that any applicable Transition Panels fit properly before anchoring Backup. Drill anchor holes in pad using the Backup as template. Anchor the Backup to the concrete pad using an approved adhesive kit (p. 13).

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

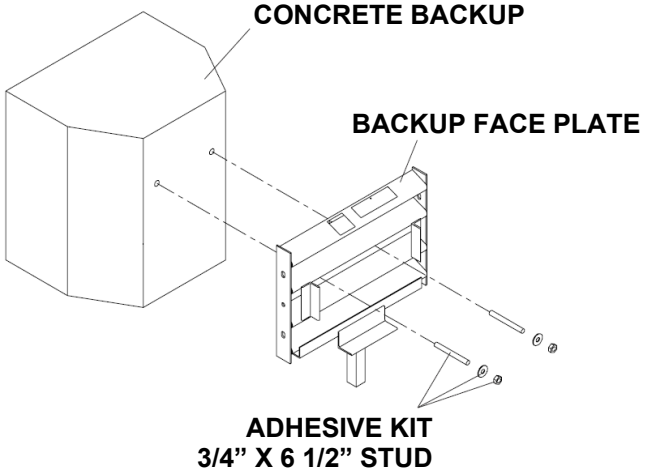


Figure 16
Anchoring Backup Face Plate to Concrete Backup

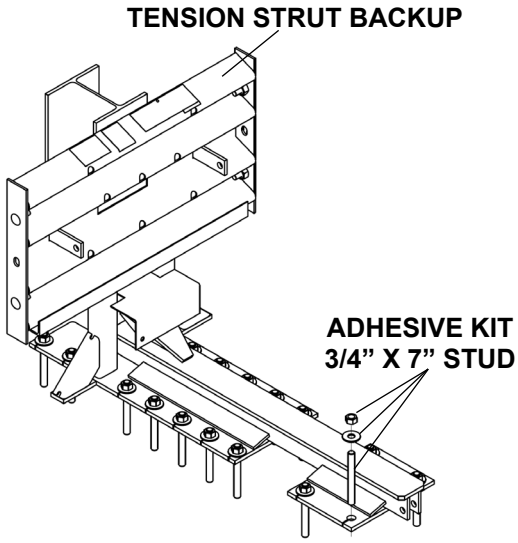


Figure 17
Anchoring Tension Strut Backup to Foundation

C. For Monorail Deployment (Figures 19 and 20)

Locate Monorail using the Monorail Assembly drawing. Drill anchor holes using Monorail as a template. Anchor Monorail using the approved adhesive kit provided. It is important to attach each segment of Monorail in alignment from the back to the front of the system (± 1/4” [6 mm]).

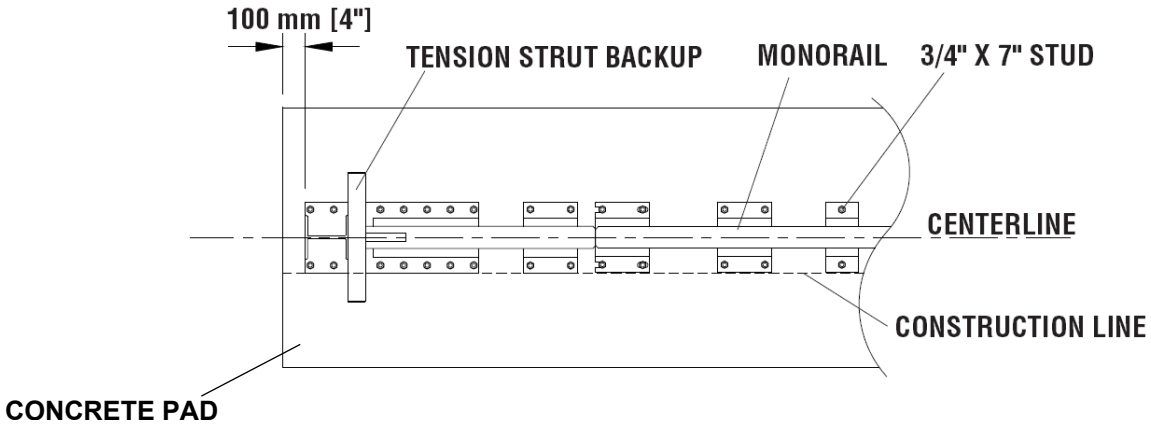


Figure 18
Backup and Monorail Location for Tension Strut Backup

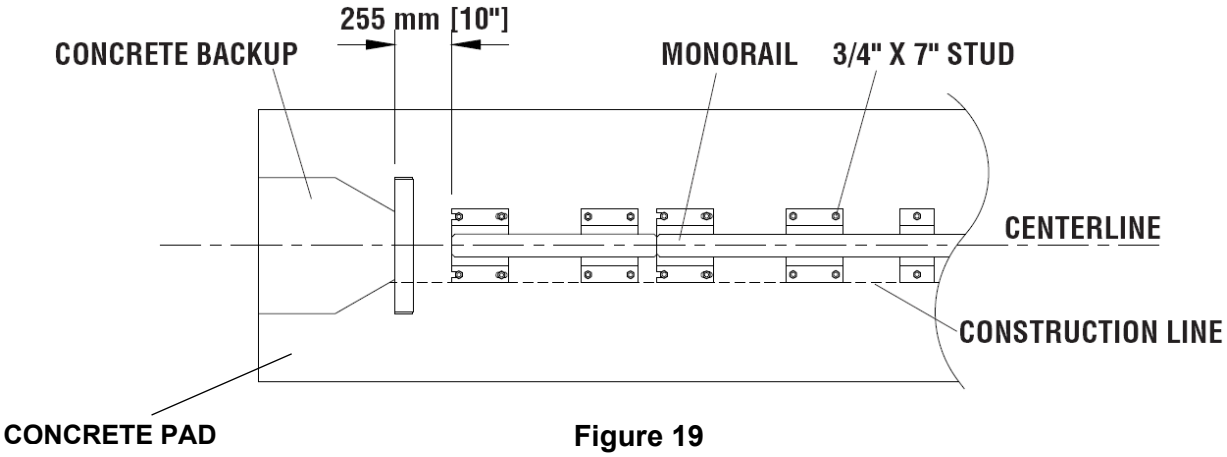


Figure 19
Monorail Location for Concrete Backup

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

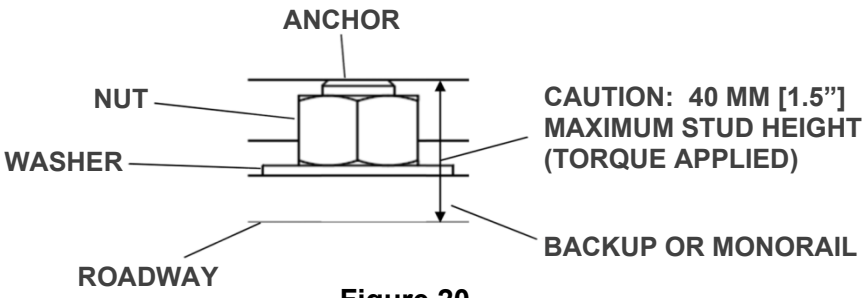


Figure 20
Proper Stud Height
(Torque Applied)

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

Attach the Transition Panel or Side Panel as appropriate to each side of Backup. Refer to Figure 21 and the drawing package for more information.

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

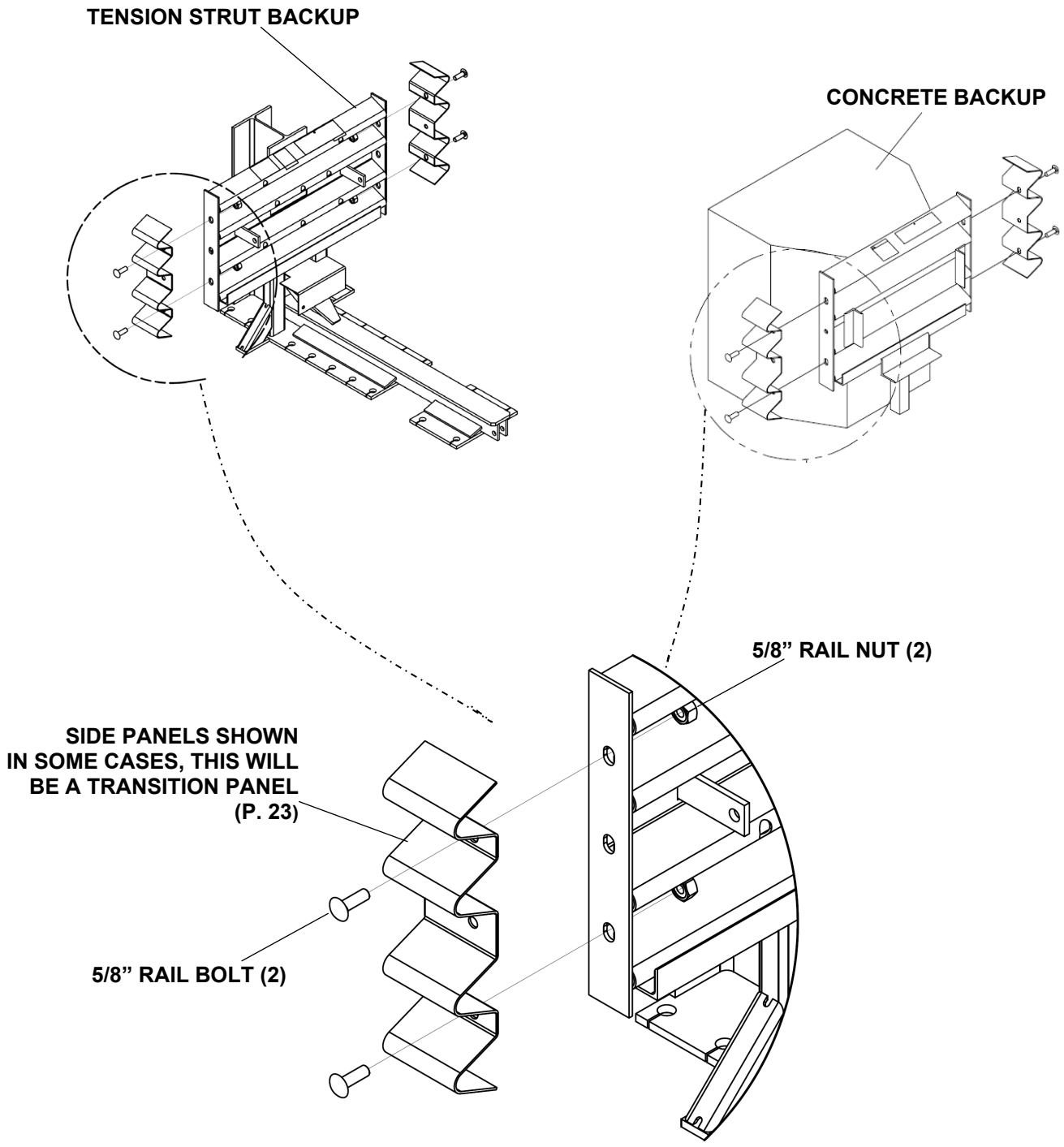


Figure 21
Side Panel/Transition Panel Attachment

4) Attach Monorail Guides

Attach Monorail guides to Diaphragms as shown in Figures 22, 23, and the Diaphragm Assembly drawing.

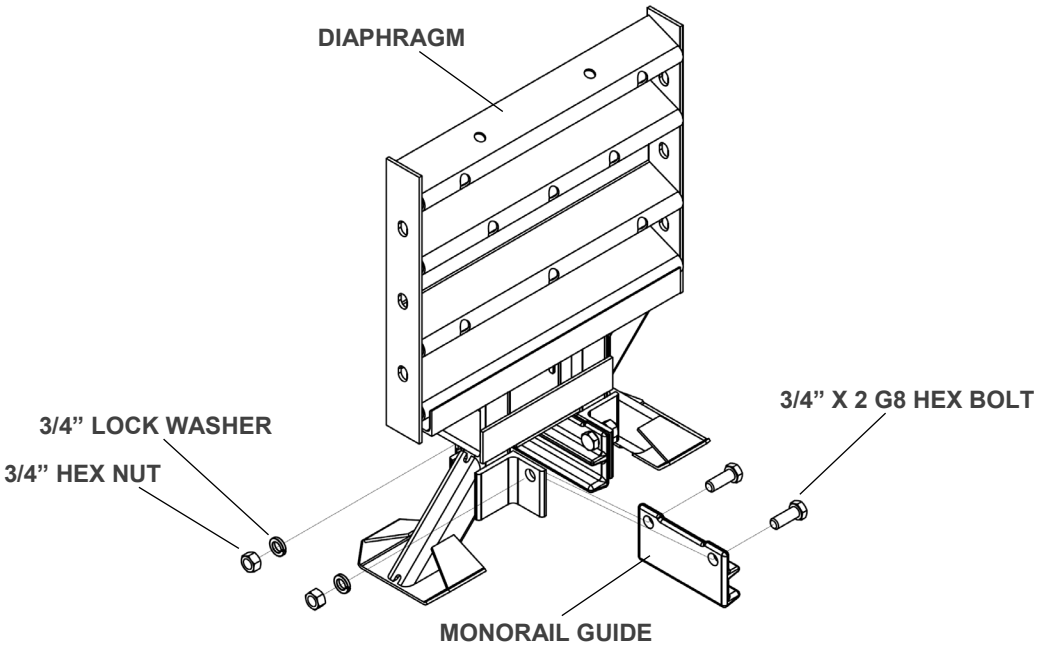


Figure 22
Monorail Guide Attachment
(Diaphragms 4 through 9)

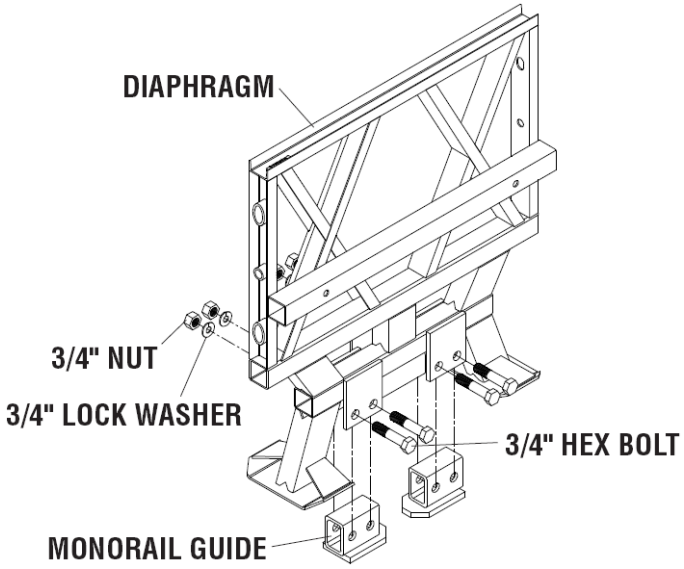


Figure 23
Monorail Guide Attachment
(Diaphragms 1, 2, and 3)

5) Attach Quad-Beam Diaphragms

Orient a Quad-Beam Diaphragm so that the front face of the Quad-Beam shape faces toward the nose of the system (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 then slide the Diaphragm forward to approximately 36” [915 mm] in front of the Backup. Orient and slide all other Quad-Beam Diaphragms onto Monorail and position each approximately as shown in Figure 26.

6) Attach HS Diaphragms

Orient an HS Diaphragm so that the square tube faces toward the Nose of the system (Figure 25). One at a time, slide the HS Diaphragms onto the Monorail and position each approximately 36” [915 mm] forward of the previous diaphragm (Figure 26).

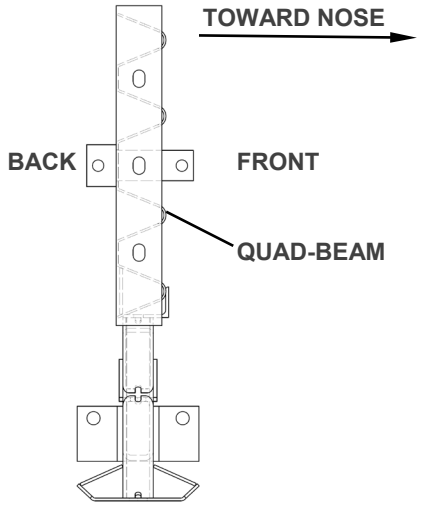


Figure 24
Quad-Beam™ Diaphragm Orientation
(Diaphragms 4 through 9)

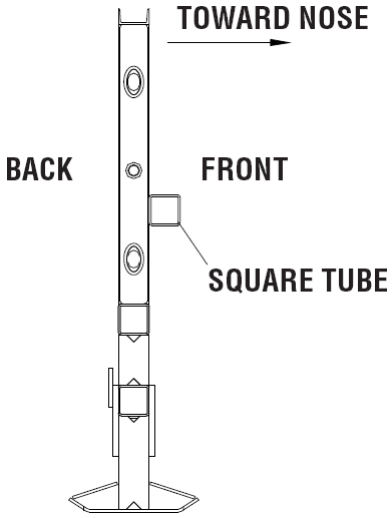


Figure 25
HS Diaphragm Orientation
(Diaphragms 1, 2, and 3)

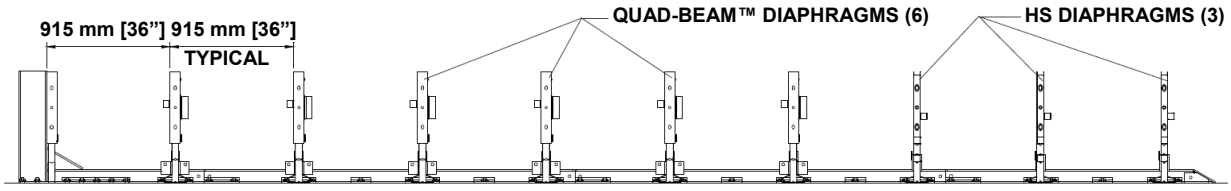


Figure 26
Diaphragm spacing

7) Attach Fender Panels

Note: Do not mix the 5/8” rail nuts (large) with the 5/8” hex nuts (small) (Figure 27).

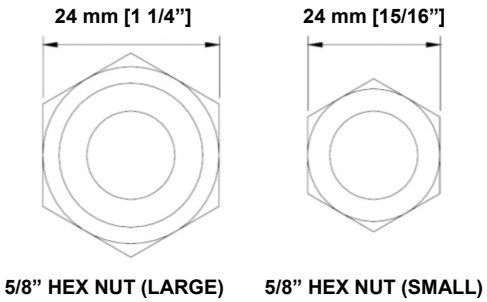


Figure 27
(Rail Nuts are Over Sized)

Starting at the Backup, attach left and right Fender Panels (Figure 28).

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

Attach Mushroom Washer Assembly as shown in Figure 28 and 29, but do not torque at this time.

After the first set of Fender Panels is attached to the third diaphragm from the front, attach Bumper Assembly for Diaphragm 3. Attach next set of Fender Panels and attach Bumper Assembly for Diaphragm 2. Repeat for Diaphragm 1 (Step 8 – “Attach Bumper Assembly”).

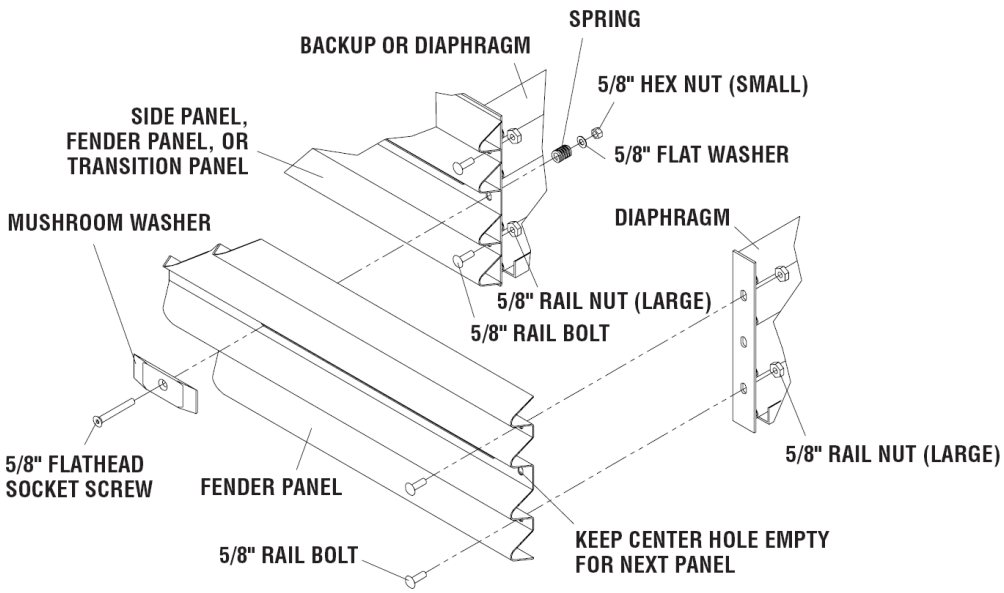
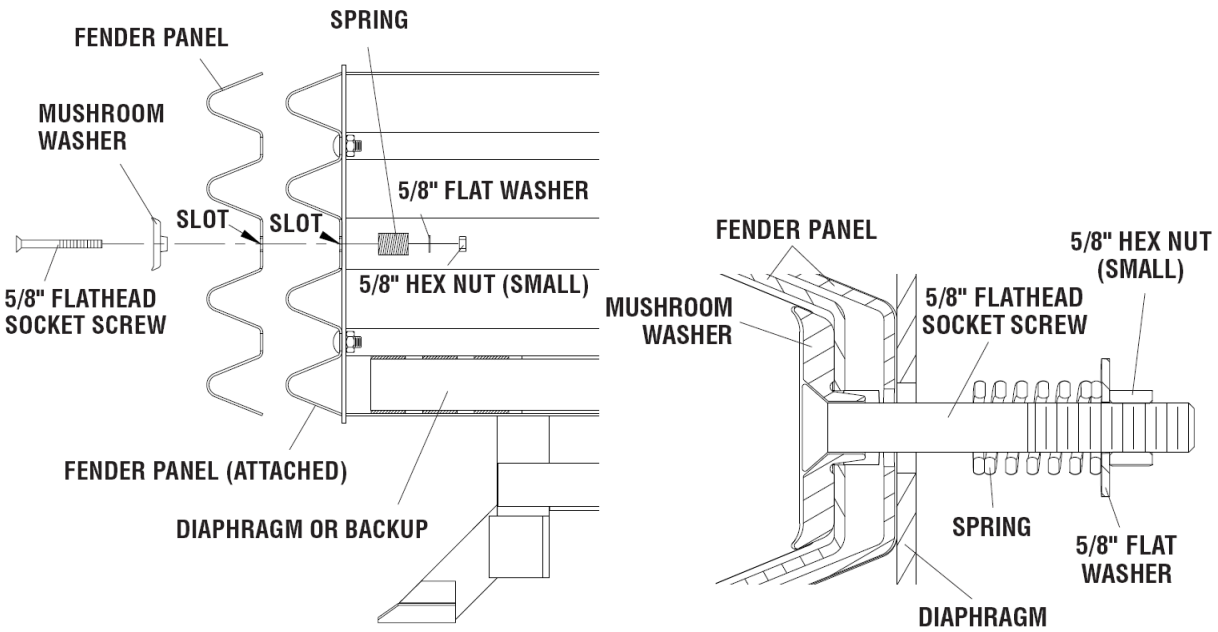


Figure 28
Fender Panel Assembly

Be sure the Mushroom Washer lays flat against the Fender Panel (Figure 29). Standoff on Mushroom Washer must be seated completely through slot.



Detail A
Mushroom Washer Attachment

Detail B
Mushroom Washer Detail

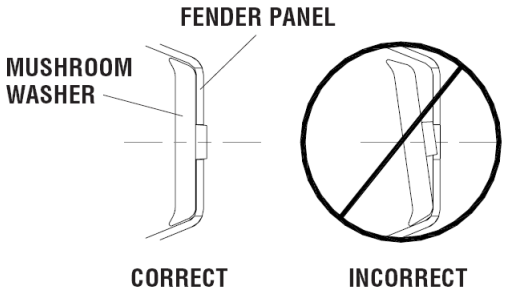


Figure 29
Mushroom Washer Orientation

Check Diaphragm spacing to ensure 36” [915 mm] between rear faces of consecutive Diaphragms (Figure 30). Once the proper spacing has been achieved, tighten the Mushroom Washer Assembly (small hex) nuts to hold the Diaphragm and Fender Panels in place during assembly of the rest of the system. Assemble the remaining Diaphragms and Fender Panels following the same procedures.

After the entire system has been assembled, tighten all of the Mushroom Washer nuts until they reach the shank of the bolt and run out of threads.

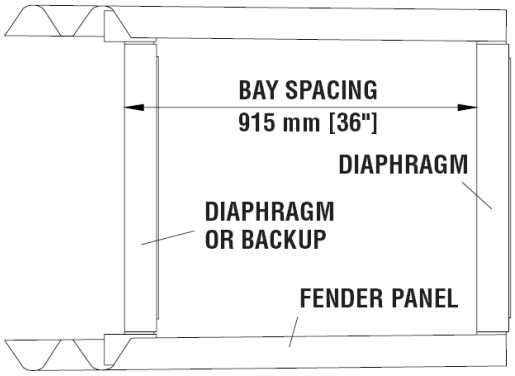


Figure 30
Proper Bay Spacing

8) Attach Bumper Assembly

A. Use 1/2" x 3” bolts, 1/2" flat washers and 1/2" nuts to attach Bumper to front of Diaphragm 3. Hang Cartridge Support Bracket onto the lower rear of Diaphragm 3 (Figure 31).

B. Using 1/2" x 8” bolts, 1/2" flat washers and 1/2" nuts, attach Bumper to front, and Spacer to rear of diaphragm 2 (Figure 32).

C. Using 1/2" x 8” bolts and 1/2" nuts, attach Spacer to rear of Diaphragm 1 (Figure 33).

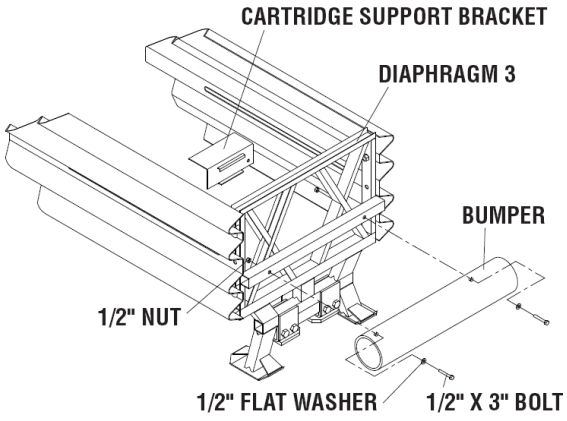


Figure 31
Bumper and Cartridge Support Bracket Assembly (Diaphragm 3)

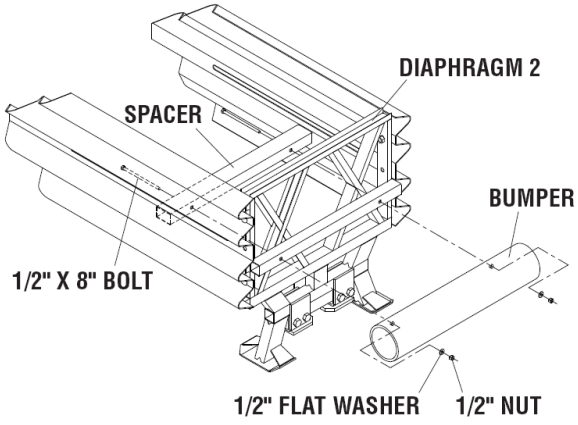


Figure 32
Bumper and Spacer Assembly (Diaphragm 2)

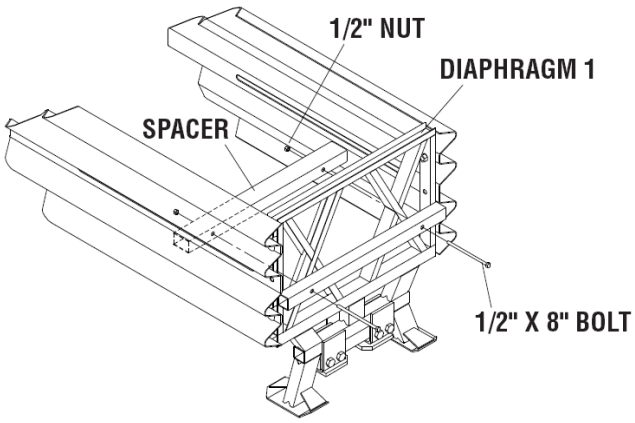


Figure 33
Spacer Assembly (Diaphragm 1)

9) Attach End Cap

Assemble End Cap to the Monorail (Figure 34 and the Monorail Assembly drawing).

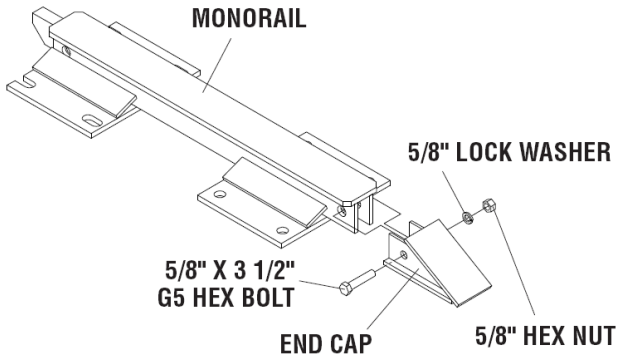


Figure 34
Monorail end Cap Assembly

10) Attach Cartridge Support Brackets

Attach lower Cartridge Support Bracket to all diaphragms and Backup as shown in Figures 36 and 37 and the Diaphragm Assembly drawing.

Note: 24” [610 mm] wide systems do not have side Cartridge Support Brackets: 30” [760 mm] and 36” [915 mm] wide systems have side Cartridges Support Brackets welded to the Backup and Diaphragms (Figure 35).

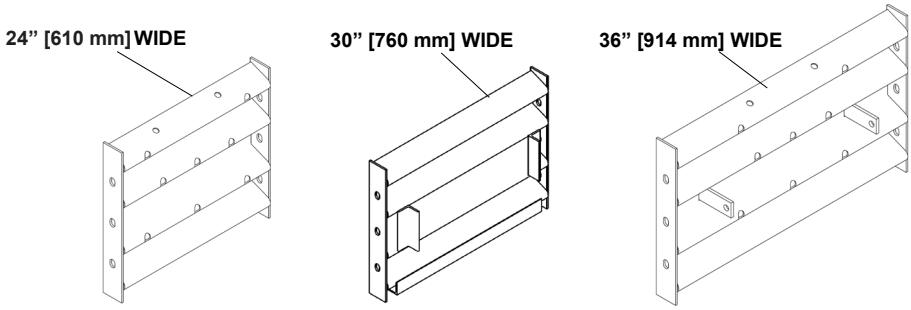


Figure 35
Side Cartridge Support Brackets

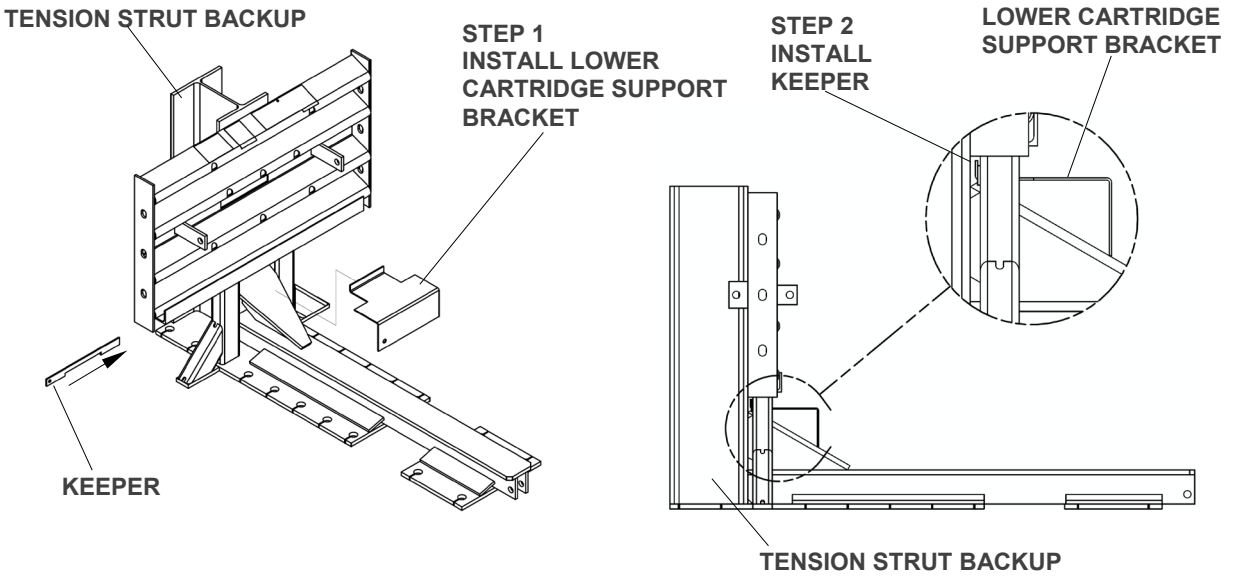


Figure 36
Lower Cartridge Support Bracket Assembly (Backup)

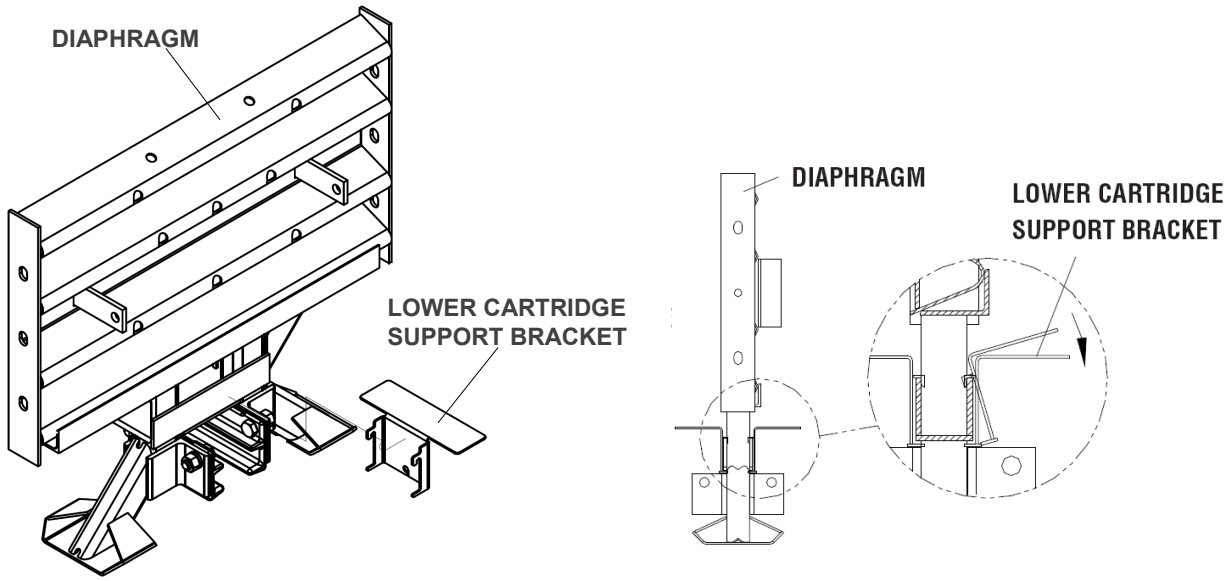


Figure 37
Lower Cartridge Support Bracket Assembly (Diaphragm)

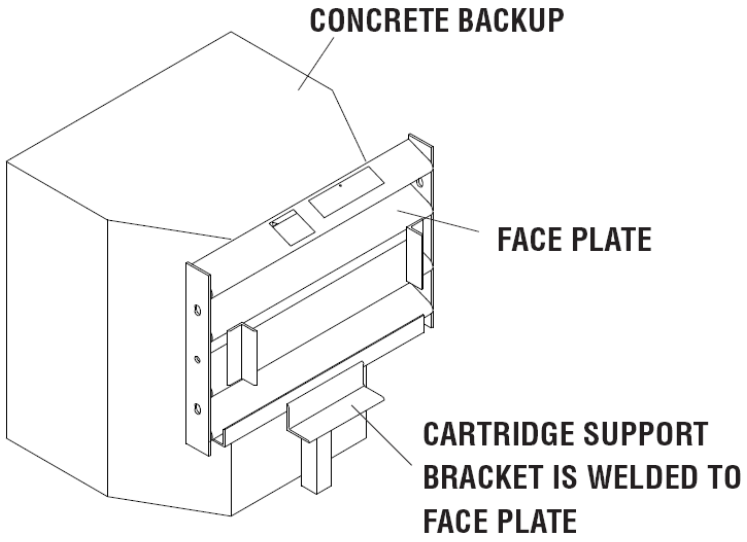


Figure 38
Lower Cartridge Support Bracket
(Concrete Backup)

11) Attach Nose Belt

Attach the Nose Belt to the Fender Panels using six (6) 5/8” threaded rods (Figure 39).

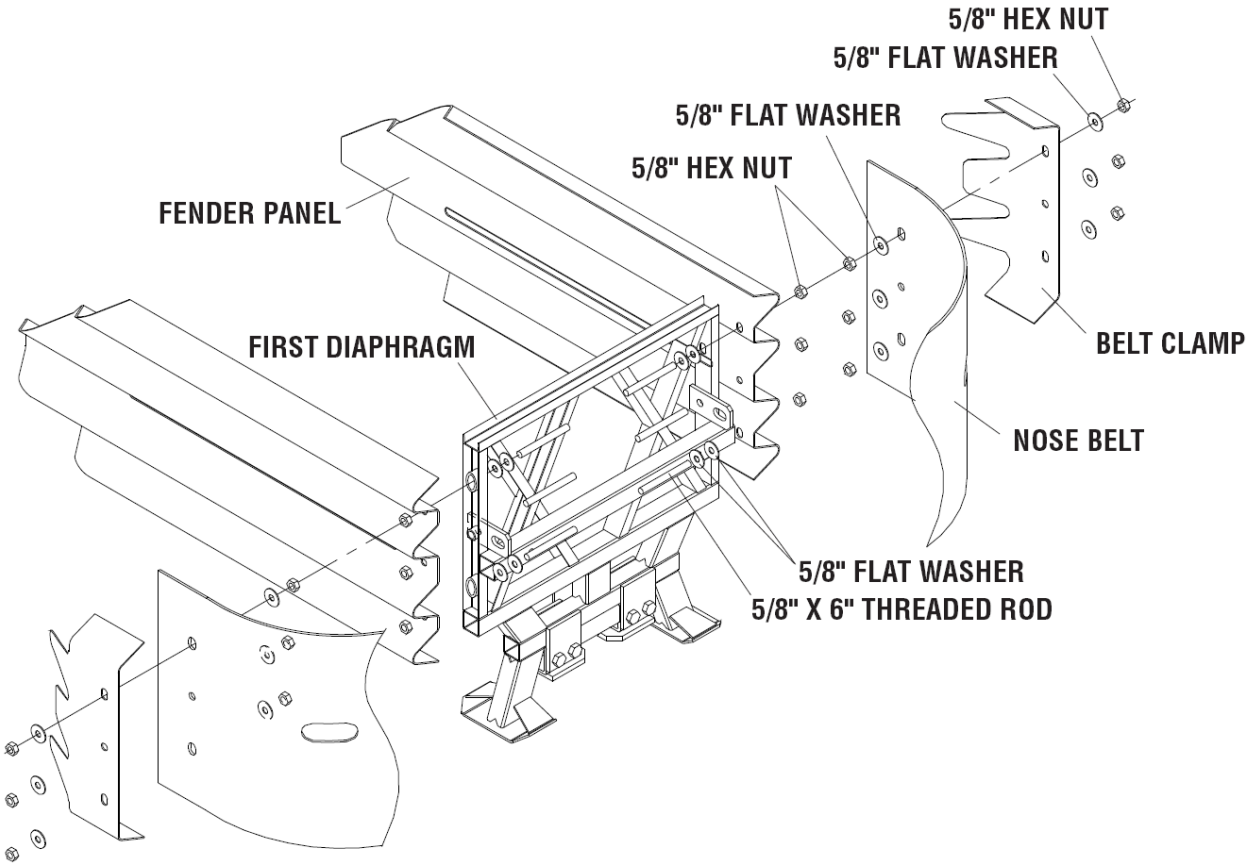


Figure 39
Nose Belt Assembly

Warning:	
Anchor Studs….	Torque to manufacturer spec Should not protrude above nuts
All Other Bolts…	Tightened
Fender Panel….	Maximum gap allowed: **Narrow Systems – 3/4” [20 mm]**

12) Checking the System Assembly

At this point recheck to ensure that all fasteners are properly tightened throughout the system (anchor bolts, etc.). **See Caution below**. Check all Fender Panels. If they do not fit tightly against the underlying panel, then system realignment is required (Figure 40).

Caution: To prevent excessive vehicle interaction during wrong-way impacts, all exposed Fender Panel gaps on the bidirectional side of the system (where traffic travels from the rear to the Nose of the system), including the last Fender Panel attached to a transition, should not exceed 3/4” [20 mm] (Figure 40).

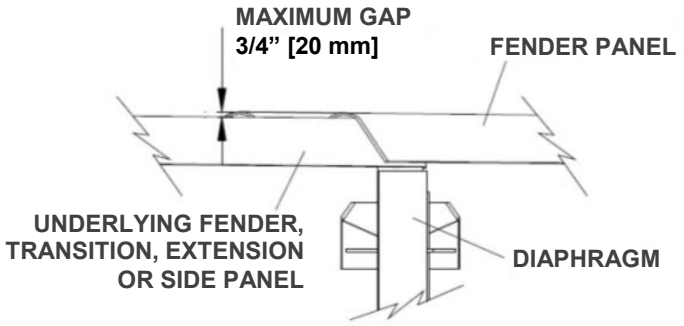


Figure 40
Fender Panel or Transition Panel Gap
Narrow Systems

13) Cartridge Placement

To complete the assembly of a QuadGuard® HS system, place the appropriate Cartridge in each Bay of the system as shown in Figure 41. The first two bays should not contain Cartridges. Type I Cartridges are placed in Bays 3 and 4; Type II Cartridges are placed in Bays 5 through 9.

Warning: Placing a Cartridge in the first or second Bays, or placing a Cartridge in the wrong Bay, may result in unacceptable crash performance as described in NCHRP Report 350.

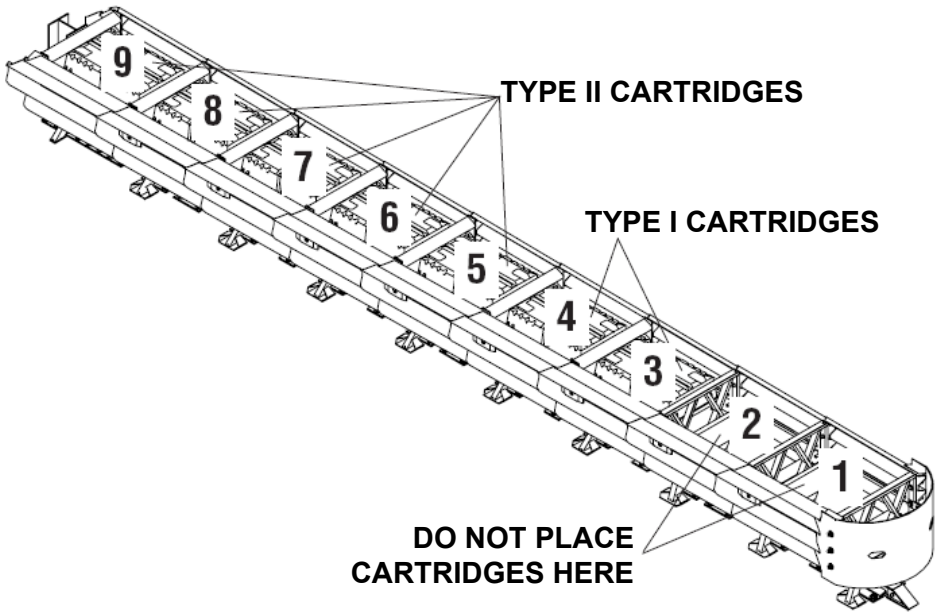


Figure 41
Cartridge Placement

QuadGuard® HS Wide

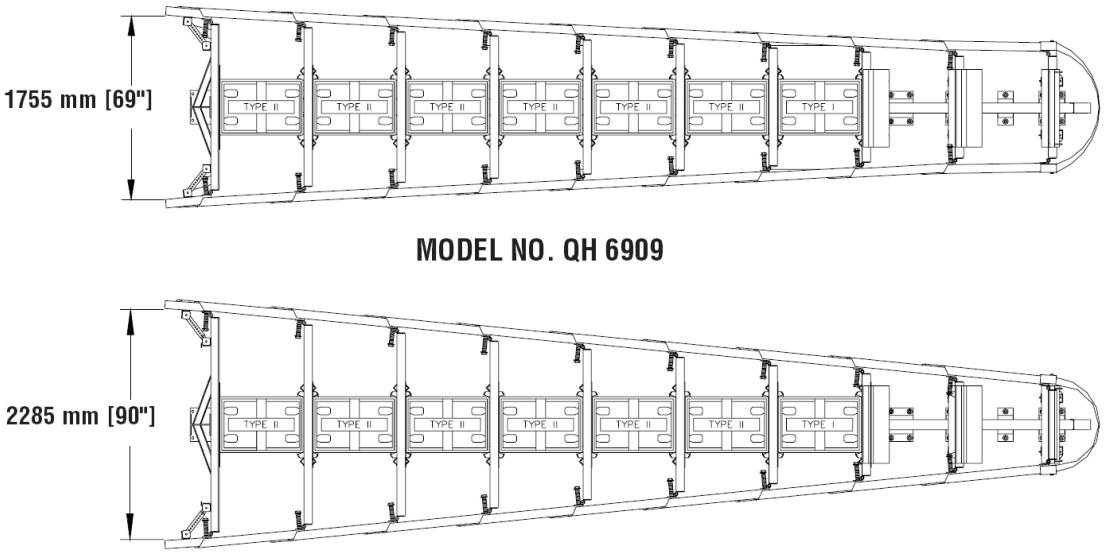


Figure 42
QuadGuard® HS Wide

Wide Transitions

A Transition Panel or Side Panel will be used on each side of the Backup (Figure 43). A Side Panel is not needed when a Transition Panel is used. Several types of Transitions are available for use with the QuadGuard® HS Wide. Refer to Figures 44 through 48 and the drawing package to determine which type of Transition Panel is being attached.

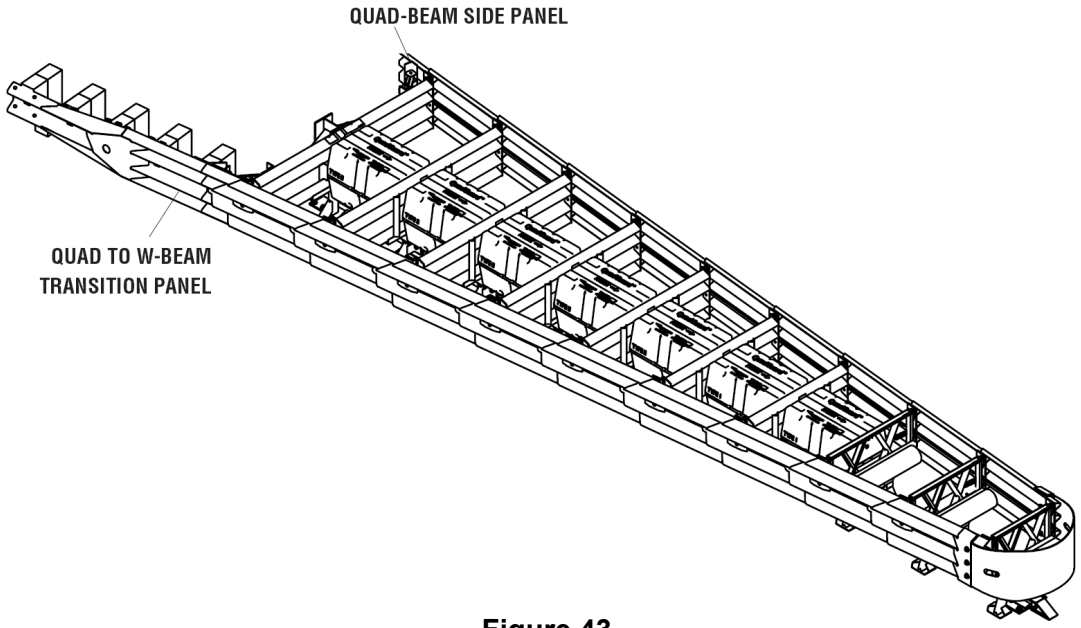


Figure 43
QuadGuard® HS Wide with Transition Panel

Figure 44
Side Panel

Note: The proper Transition or Side Panel must be used for optimum 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® HS is shielding. Contact the Customer Service Department prior to assembly if you have any questions (p. 3).

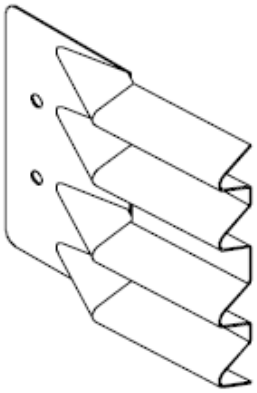


Figure 45
End Shoe

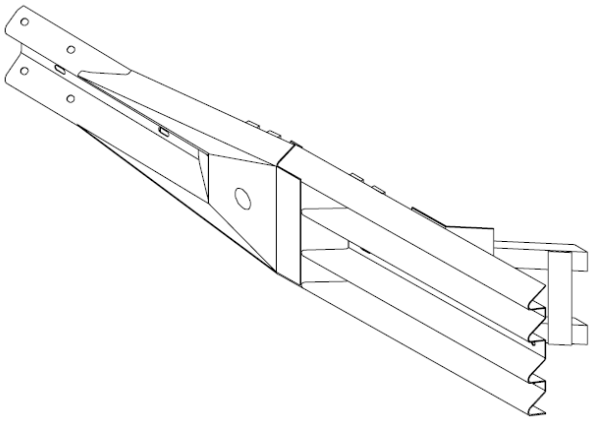


Figure 46
W-Beam Transition Panel

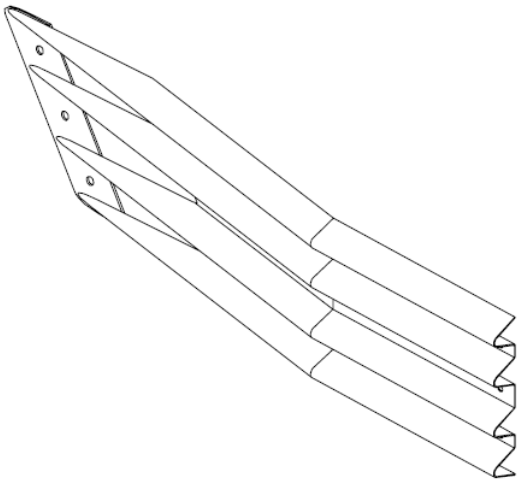


Figure 47
Safety Shape Barrier Transition Panel

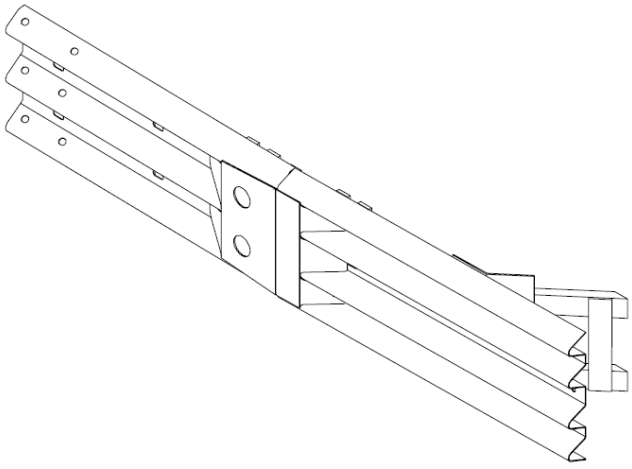


Figure 48
Thrie-Beam Transition Panel

Assembly Wide

1) Mark System Location

Locate the centerline of the system by measuring the proper offset from the hazard. Refer to 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 49. The edge of the Monorail will be placed on this line.

Note: The concrete pad should be placed per the project plans supplied with the system.

Caution: Location of the QuadGuard® HS with respect to the hazard is critical and dependent on the type of Transition Panel used. See the project plans supplied with your system for details.

Figure 49
(Top view of Foundation)
Locating Construction Line

2) Anchor the Backup and Monorail

Refer to Figure 50 (Tension Strut Backup Assembly), Figure 51 (Monorail Assembly) and the drawing package for more information.

A. For Tension Strut Backup Assembly (Figure 50)

Locate Tension Strut Backup and Monorail on foundation with side of Monorail on the construction line (Figure 49). 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 the approved adhesive kits provided (p. 13).

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

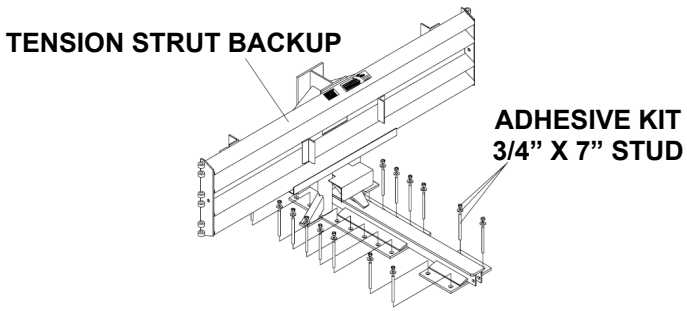


Figure 50
Anchoring Tension Strut Backup to Foundation

B. For Monorail Assembly (Figures 51)

Locate Monorail using the Monorail Assembly drawing. Drill anchor holes using Monorail as a template. Anchor Monorail using the approved adhesive kits provided. It is important to assemble each segment of Monorail in alignment from the back to the front of the system (±1/4” [6 mm]).

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

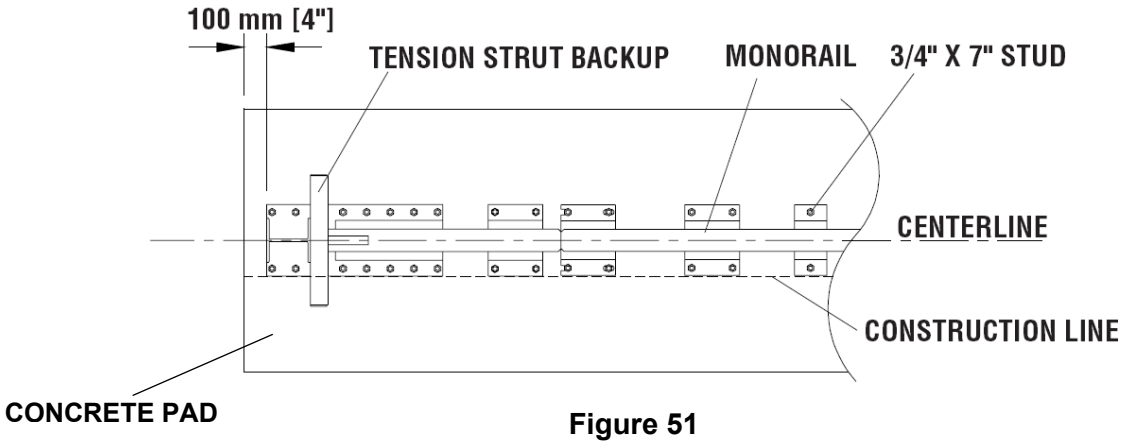


Figure 51
Backup and Monorail Location for Tension Strut Backup

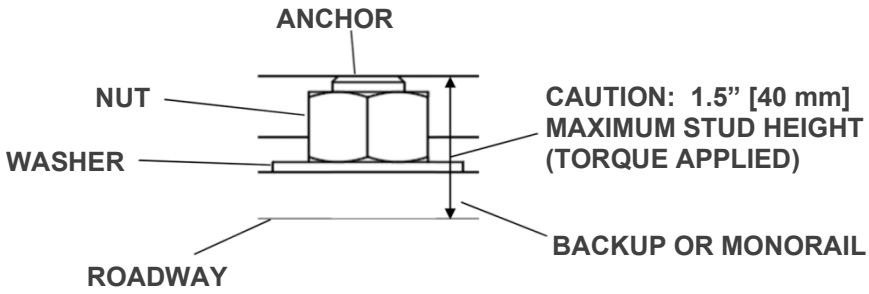


Figure 52
Proper Stud Height
(Torque Applied)

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

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

B. Attach Transition Panel or Side Panel assembly to side of Backup using 5/8” hex bolt, 5/8” lock washer and 5/8” hex nut three places each side of Backup (Figure 53).

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; four 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 53.

Note: A Side Panel is not needed when a Transition Panel is used. Refer to the drawing package as Diagonal Braces are not used with some Transition Panels.

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.

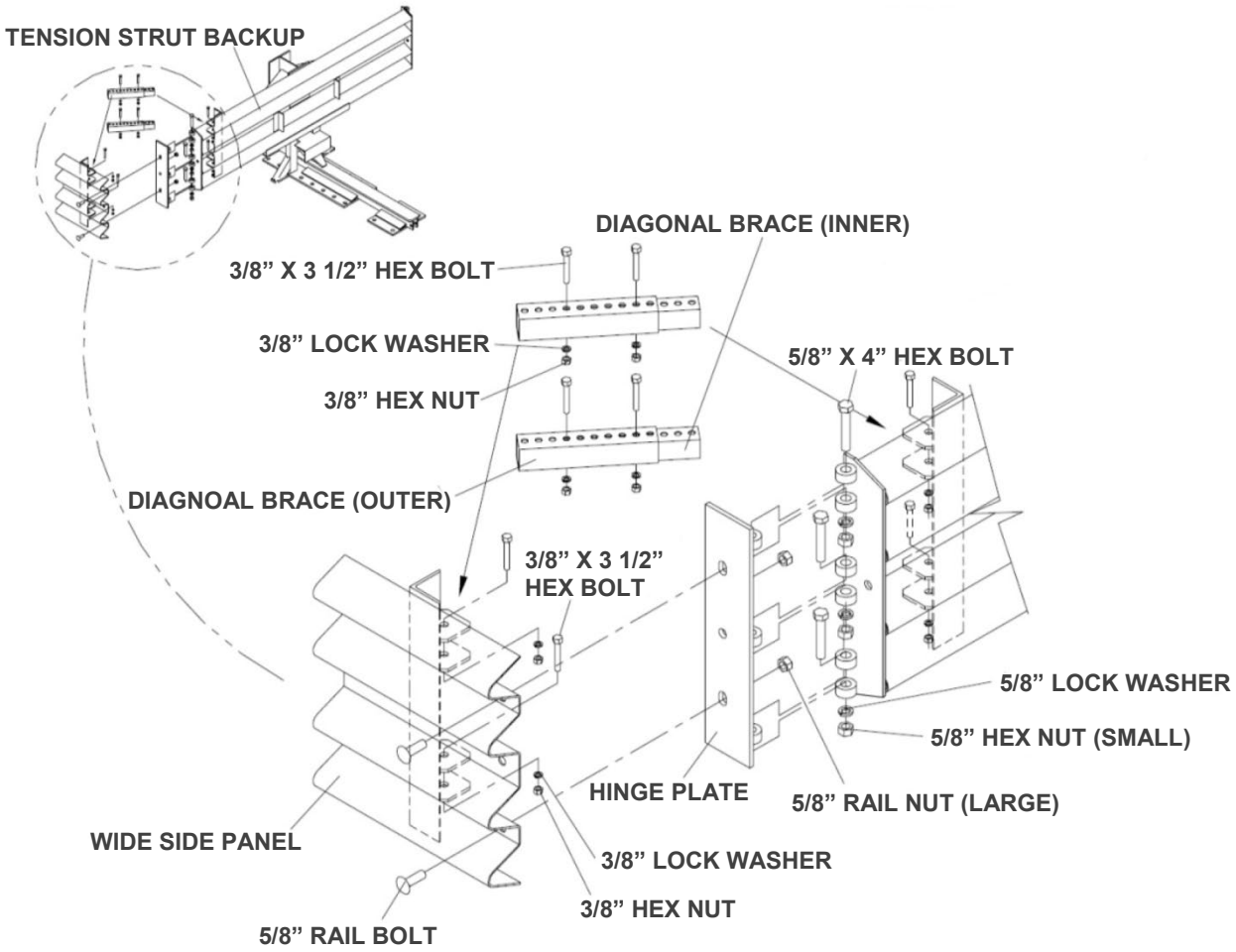


Figure 53
Side Panel/Transition Panel Attachment

4) Attach Monorail Guides

Attach Monorail Guides to diaphragm as follows:

Insert 3/4 x 2" G8 hex bolt through Monorail Guide and diaphragm, oriented as shown in Figures 54 and 55. Secure with 3/4" lock washer and 3/4" nut (typical two places per guide). See also diaphragm assembly drawing.

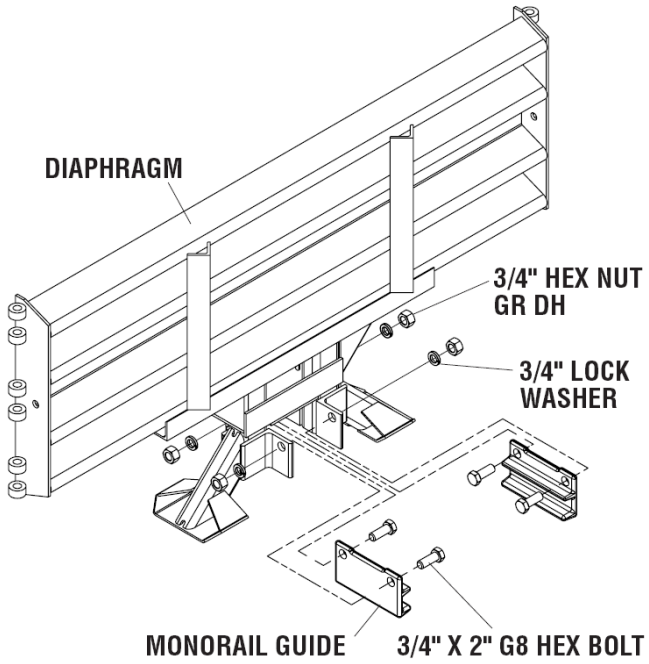


Figure 54
Monorail Guide Attachment
(Diaphragms 4 through 9)

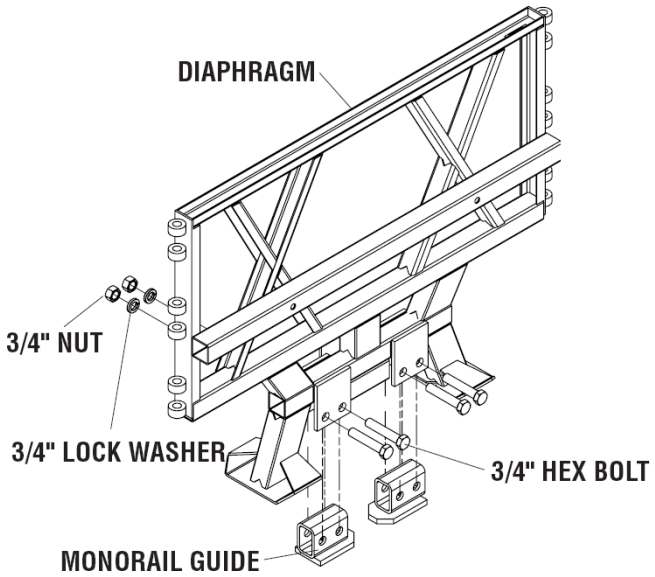


Figure 55
Monorail Guide Attachment
(Diaphragms 1, 2, and 3)

5) Attach Quad-Beam™ Diaphragms

Orient a Quad-Beam™ diaphragm so that the front face of the Quad-Beam™ shape faces toward the Nose of the system as shown in Figure 56. 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 then slide the Diaphragm forward to approximately 36” [915 mm] in front of the Backup. Orient and slide all other Quad-Beam™ Diaphragms onto Monorail and position each approximately as shown in Figure 58.

6) Attach HS Diaphragms

Orient an HS diaphragm so that the square tube faces toward the Nose of the system as shown in Figure 57. One at a time, slide the HS Diaphragms onto the Monorail and position each about 36” [915 mm] forward of the previous Diaphragm as shown in Figure 58.

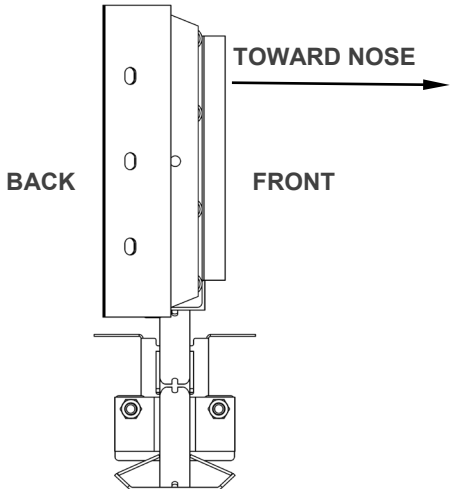


Figure 56
Quad-Beam Diaphragm Orientation
(Diaphragms 4 through 9)

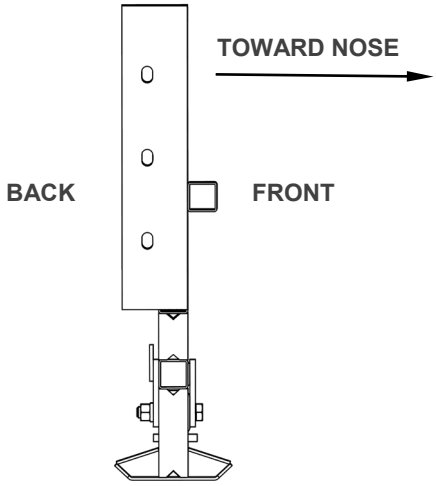


Figure 57
HS Diaphragm Orientation
(Diaphragms 1, 2, and 3)

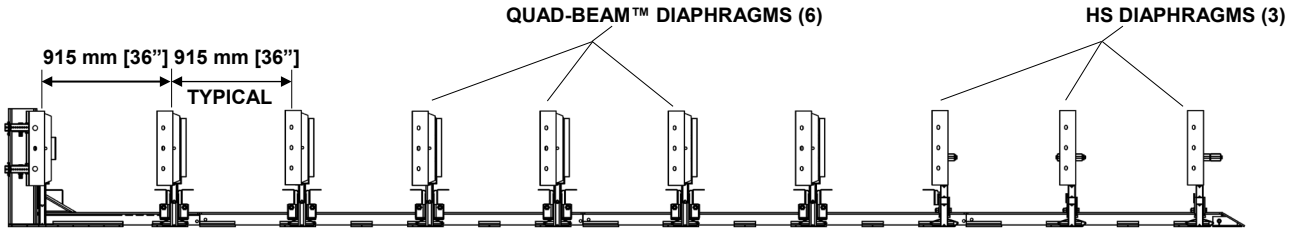


Figure 58
Diaphragm Spacing

7) Attach Hinge Plate onto Fender Panels

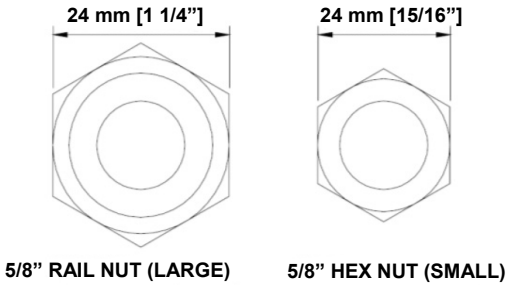


Figure 59
(Rail Nuts are Oversize)

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

Attach a 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.

Note: Rail Nuts are oversized (Figure 59).

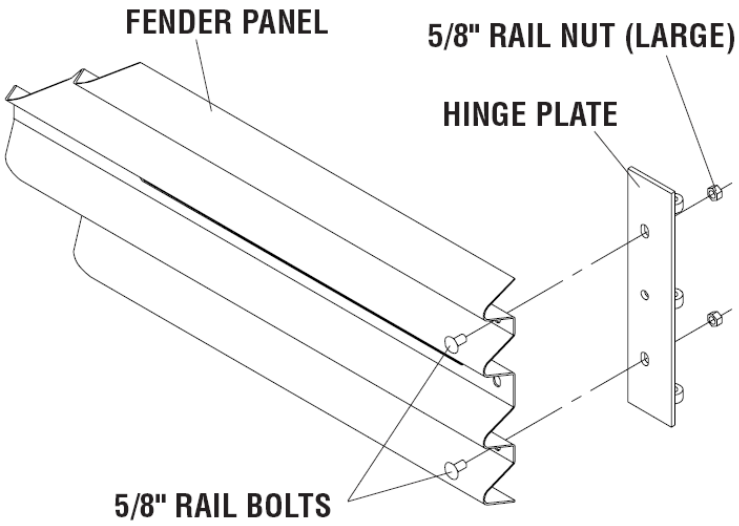
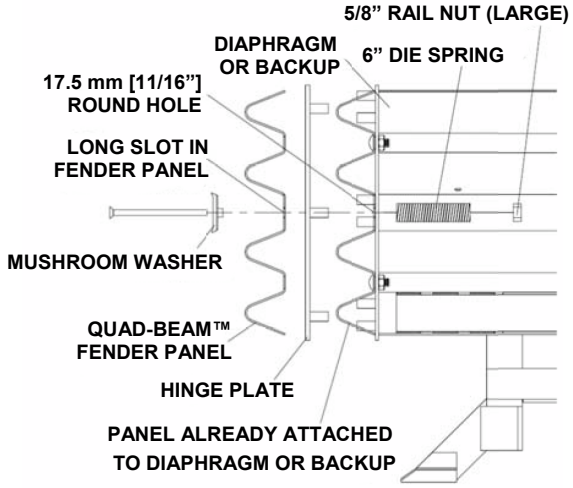


Figure 60
Hinge Plate Assembly

8) Attach Fender Panels

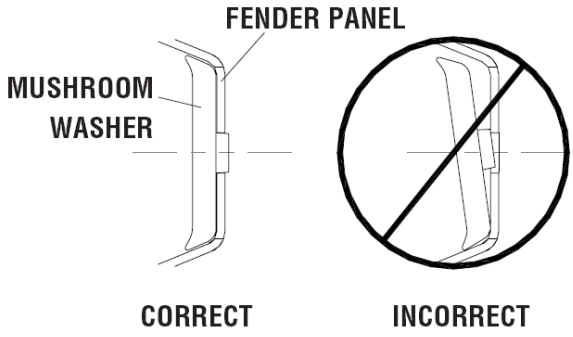
Starting at the last Bay, attach left and right Fender Panels as shown in Figure 62. Attach the Hinge Plate at the front of the Fender Panels to the Diaphragm in front using three 5/8” hex bolts, nuts, and washers.

Attach Mushroom Washer assembly as shown in Figure 62, Detail A, and Detail B; do not torque at this time.



Detail A
Mushroom Washer Assembly

Mushroom Washer must lay flat against the Fender Panel as shown in Detail B. Standoff on washer must be fully seated through slot.



Detail B
Mushroom Washer Orientation

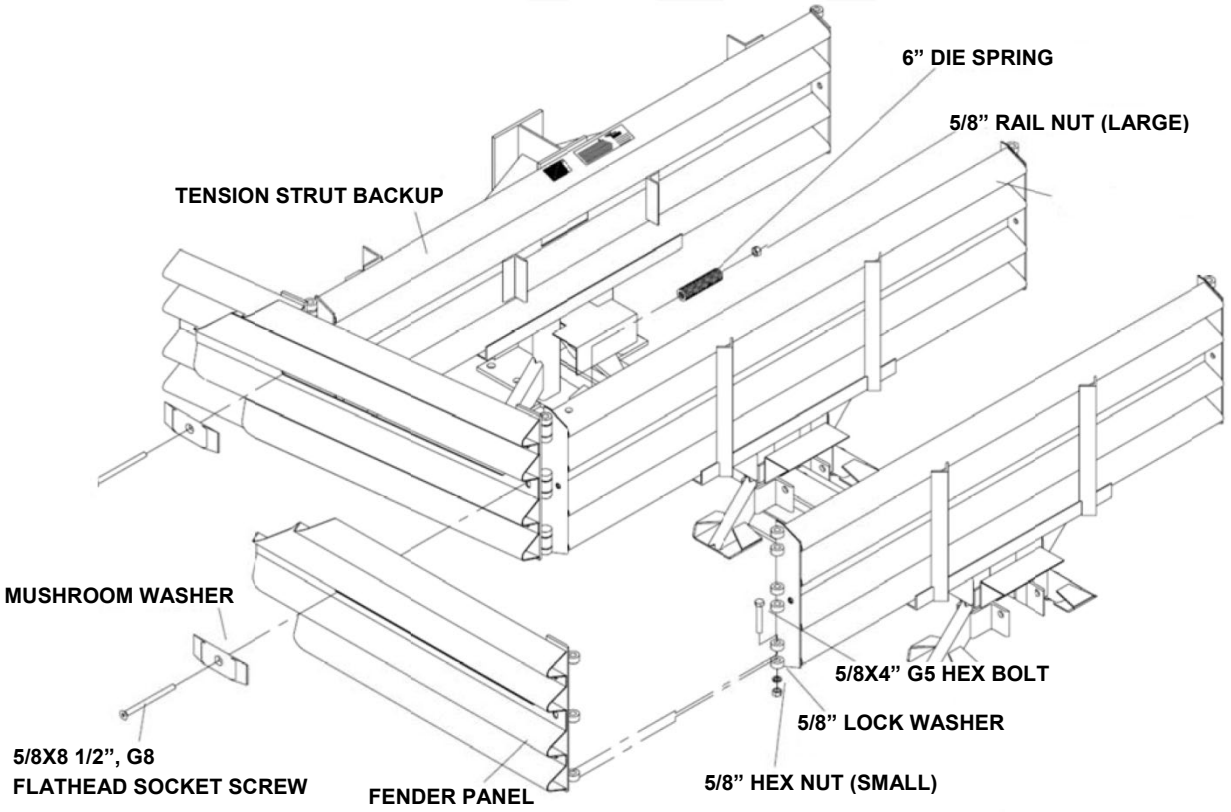


Figure 61
Fender Panel Assembly

Check Diaphragm spacing to ensure 36” [915 mm] between rear faces of consecutive Diaphragms as shown in Figure 62. Once the proper spacing has been received, torque the Mushroom Washer assembly (large hex) nuts until it reaches the end of the threads. Attach the remaining Diaphragms and Fender Panels following the same procedures.

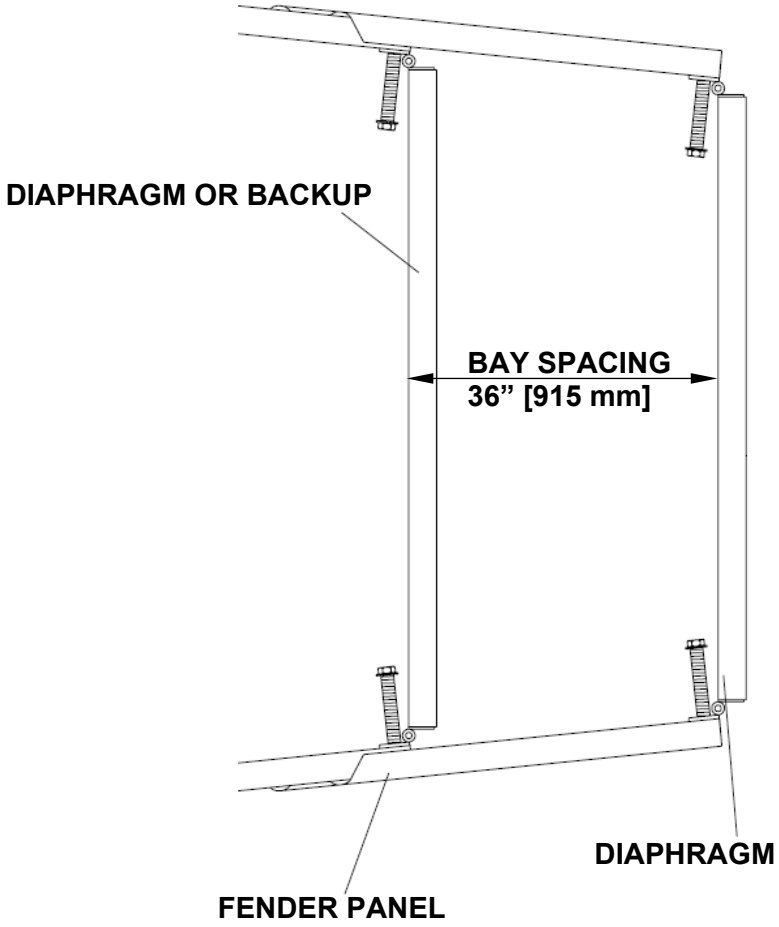


Figure 62
Proper Diaphragm Spacing

9) Attach Bumper Assembly

A. Use 1/2” x 3” bolts, 1/2" flat washers and 1/2" nuts to attach Bumper to front of Diaphragm 3. Hang Cartridge Support Bracket onto the lower rear of Diaphragm 3 as shown in Figure 63.

B. Using 1/2” x 8” bolts, 1/2" flat washers and 1/2" nuts, attach Bumper to front, and spacer to rear of Diaphragm 2 as shown in Figure 64.

C. Using 1/2" x 8” bolts and 1/2" nuts, attach spacer to rear of Diaphragm 1 as shown in Figure 65.

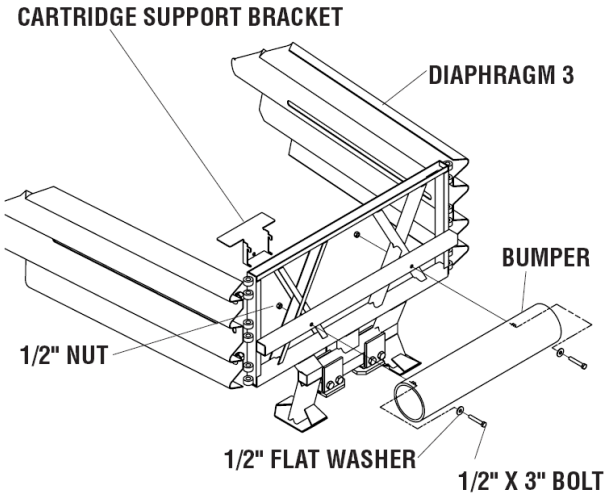


Figure 63
Bumper and Cartridge Support Bracket Assembly (Diaphragm 3)

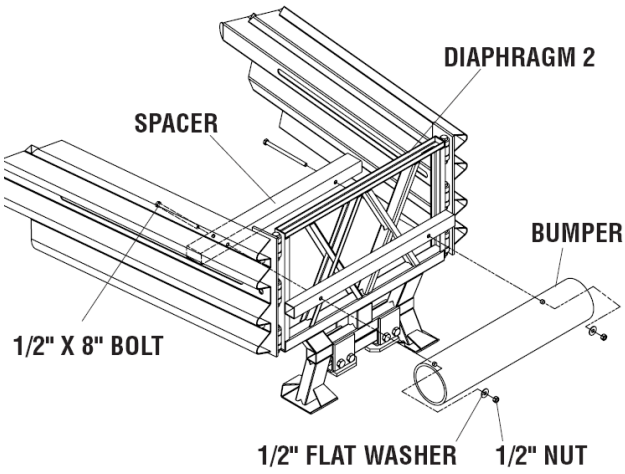


Figure 64
Bumper and Spacer Assembly (Diaphragm 2)

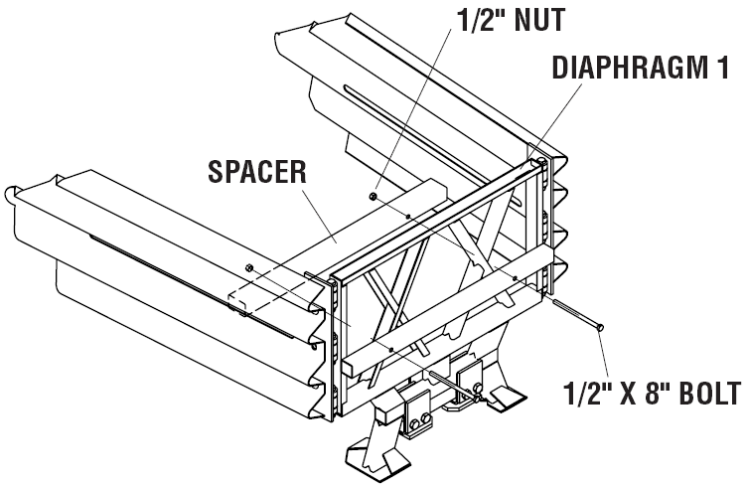


Figure 65
Spacer Assembly (Diaphragm 1)

10) Attach End Cap

Attach End Cap to the Monorail as shown in Figure 66 and the Monorail Assembly Drawing.

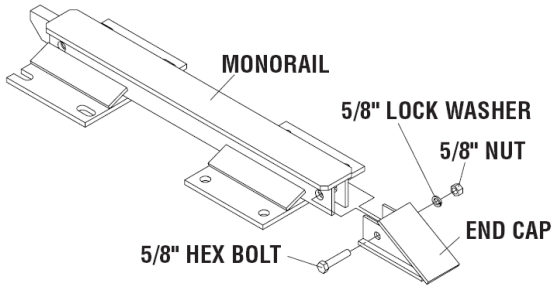


Figure 66
Monorail End Cap Assembly

11) Attach Cartridge Support Brackets

Attach lower Cartridge Support Bracket to all Diaphragms and Backup as shown in Figures 68, 69, and the Diaphragm Assembly Drawing.

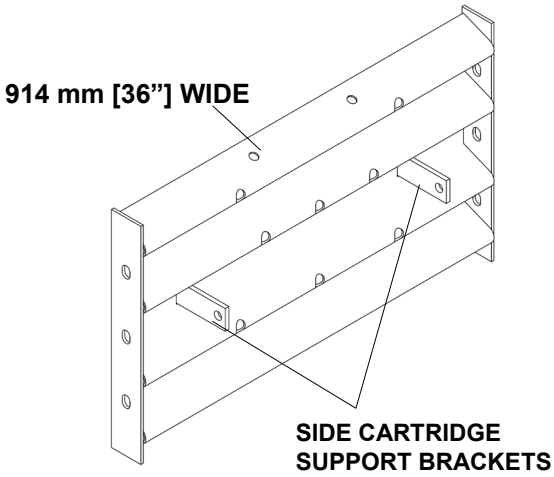


Figure 67
Side Cartridge Support Brackets

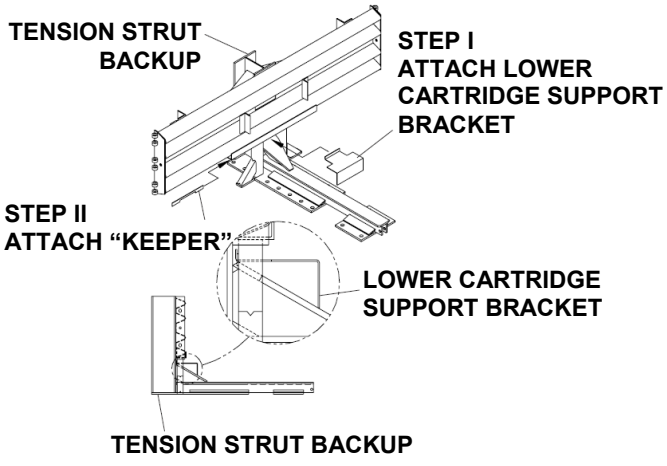


Figure 68
Cartridge Support Bracket
(Tension Strut Backup)

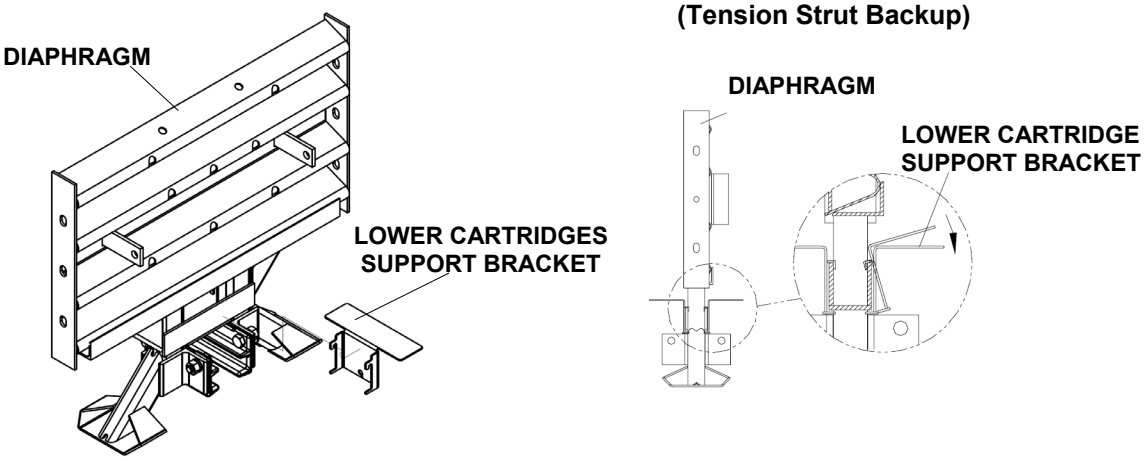


Figure 69
Cartridge Support Bracket Attachment

12) Attach Nose Belt

Attach the Nose Belt to the Fender Panels using six (6) 5/8” x 6” threaded rods as shown in Figure 70.

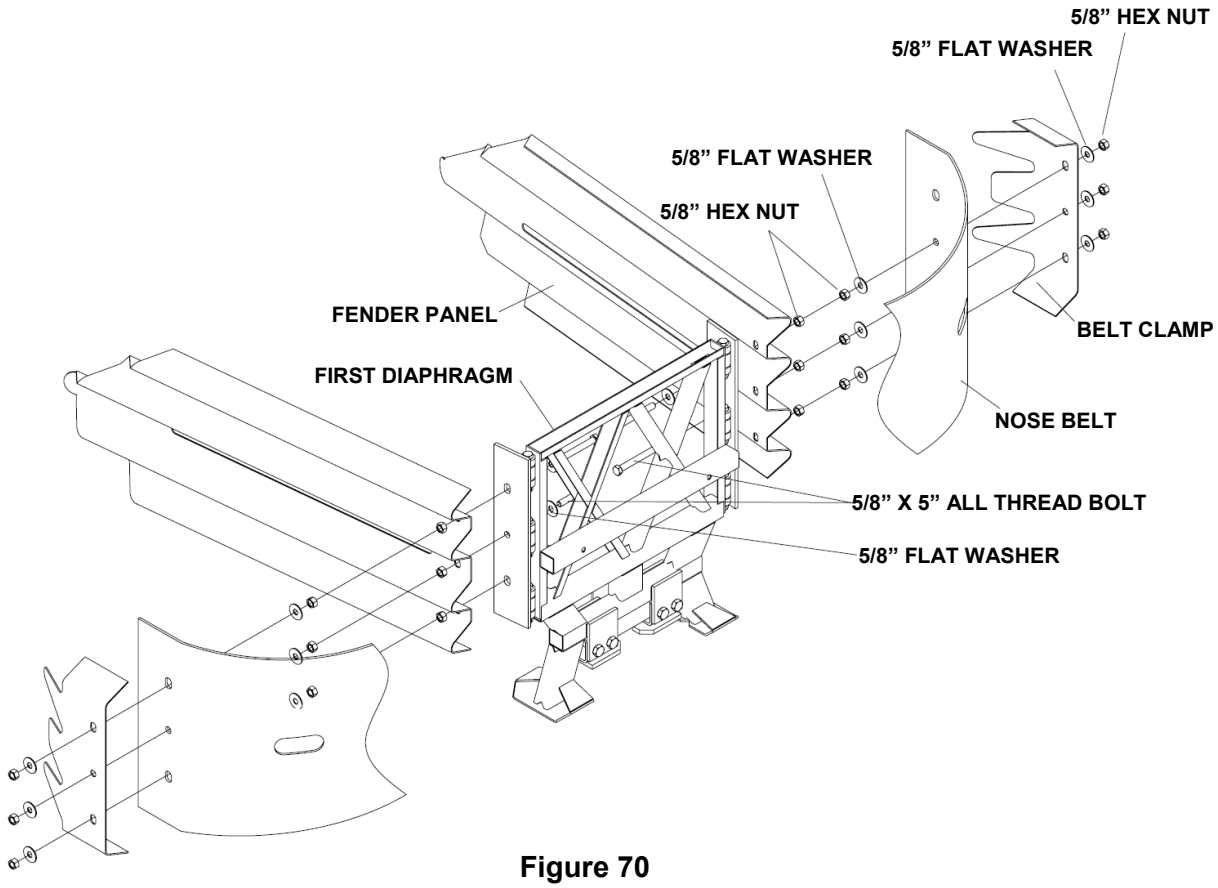


Figure 70
Nose Assembly

Warning:	
Anchor Studs….	Torque to manufacturer spec Should not protrude above nuts
All Other Bolts…	Tightened
Fender Panel….	Maximum gap allowed: **Wide Systems – 1” [25 mm]**

13) Checking the System Assembly

At this point, recheck to ensure that all fasteners are properly tightened throughout the system (anchor bolts, etc.). Check all Fender Panels. If they do not fit tightly against the underlying Panel, system realignment may be necessary (Figure 71).

Caution: To prevent excessive vehicle interaction during wrong-way impacts, all exposed Fender Panel gaps on the bidirectional side of the system (where traffic travels from the rear to the Nose of the system), including the last Fender Panel attached to the transition, should not exceed 1.00” [25 mm] (Figure 71).

14) Cartridge Placement

To complete the assembly of the QuadGuard® HS, place the appropriate Cartridge in each Bay of the system as shown in Figure 72. The first two Bays should not contain Cartridges. Type 1 Cartridges are placed in Bays 3 and 4; Type 2 Cartridges are placed in Bays 5 through 9.

Warning: Placing a Cartridge in the first or second Bay, or placing a Cartridge in the wrong Bay may result in the unacceptable crash performance as described in NCHRP Report 350.

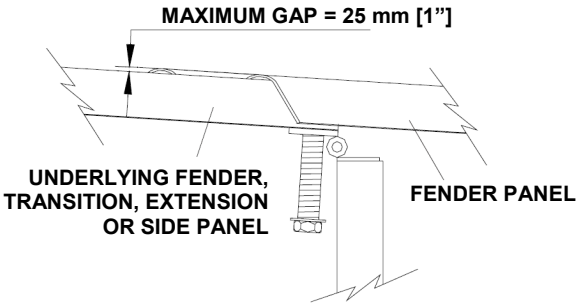


Figure 71
Wide System Fender Panel Gap

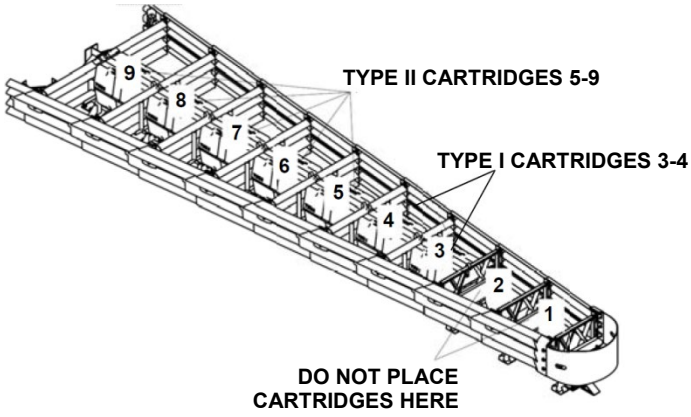


Figure 72
Cartridge Placement

QuadGuard® HS Final Inspection Checklist

Date: _____

Inspector: _____

Location: _____

- ☐ Anchors are properly torqued (p. 13)
- ☐ Unobstructed clearance of 30” behind rear Fender Panels (p. 18)
- ☐ Transition Panel fits against the hazard (no gaps) (p. 23)
- ☐ Every hole and slot in Backup and Monorail is anchored (p. 25)
- ☐ Anchor stud(s) are no higher than 1.5” above the pad (p. 26 & 42)
- ☐ If no transition, check for narrow side panels at Backup (p. 26)
- ☐ Monorail guides bolts/nuts tightened to all Diaphragms (p. 27)
- ☐ Fender Panel Mushroom Washer Nuts tightened to bolt shank (p. 30)
- ☐ Mushroom Washers lay flat in slots (p. 30)
- ☐ End Cap attached to front of Monorail (p. 32)
- ☐ Cartridges are resting on Cartridge supports in each Bay (p. 33)
- ☐ Fender Panel gap is ≤ 3/4” [20 mm] for Narrow systems (p. 35)
- ☐ Correct Cartridge types for each Bay (p. 36 & 50)
- ☐ Bolts and nuts are properly tightened (p. 35)
- ☐ Fender Panel gap is ≤ 1.00” [25 mm] for Wide systems (p. 50)

Important: It is critical that you inspect this product after assembly is complete to ensure 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 at least once a year for QuadGuard® HS systems on asphalt.

Visual Drive-By Inspection

1) Check to see if there is evidence of a hit. 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: Refer to Cartridge placement on page 38 or 52.

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

Walk-Up Inspection

1) Clear and dispose of any excessive dirt or debris around the system.
2) Be sure all bolts are tight and rust free.
3) Be sure concrete anchor bolts are securely anchored.
4) Be sure Diaphragm legs are straight.
5) Be sure all Mushroom Washer assemblies are properly aligned and positioned.
6) Fender Panels and Transition Panels should nest tightly against the system.

Warning:	
Fender Panel	Maximum gap allowed:
	Narrow Systems – 20 mm [3/4”]
	Wide Systems – 25 mm [1”]

7) Be sure Cartridges have not been damaged and are properly positioned on their Support Brackets. Replace crushed or sagging Cartridges. To ensure 100% of the intended speed characteristics, partially crushed Cartridges (due to slow speed impacts) should be replaced.

Warning: Refer to Cartridge placement on page 37 or 51.

8) Make all necessary repairs as described above. Refer to Post-Impact Instructions on the next page for more information.
9) Note the location and condition of the QuadGuard® HS system and any work done in the Impact Attenuator Inspection Logbook under the date of this inspection. If further repair is necessary, note repair request date in logbook. Refer to Post-Impact Instructions and assembly section of this manual for more information.

Post-Impact Instructions

1) Deploy the appropriate traffic-control devices to protect your crew.
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. Proper performance of the system depends on the Monorail anchors being properly deployed.

   If the 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.

Warning: QuadGuard® HS systems for wide hazards should never be anchored to asphalt.

e proper performance of the system during an angle impact depends on the Monorail anchors being properly anchored.

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 intact back to its original position.
5) Be sure that the Diaphragm Support Legs are all properly attached to the Monorail.
6) Attach 3/8” [10 mm] grade 40 chain to Pullout Brackets on first Diaphragm (Figure 73). 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.

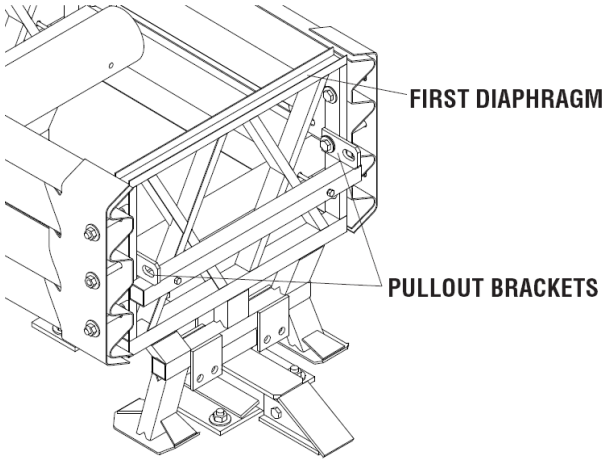


Figure 73
Pullout Bracket Locations
(Nose Belt not shown for clarity)

Pull the QuadGuard® HS 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.

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

10) Check the gaps between Fender Panels. The maximum gap allowed for these overlapping parts (including Fender Panels overlapping panels behind the system) is 3/4” [20 mm] for narrow systems and 1.00” [25 mm] for wide systems (p. 53). Ensure the Mushroom Washer Assemblies are tightened until the nuts make contact with the bolt shank. If the gaps between the Fender Panels are still too large it may be necessary to replace bent parts.

11) Replace all crushed Cartridges. Refer to Cartridge Placement on page 37 or 51.

12) Check the torque of all anchor bolts on the system (p. 13).

13) Check to be certain that the site is free from excessive dirt or debris. The QuadGuard® HS system is once again ready for use.

Parts Ordering Procedure

Make a list of all damaged parts using part descriptions shown on page 56.

Circle the appropriate system attributes below. This information is necessary to receive the proper parts.

System width: 24” [610 mm], 30” [760 mm], 36” [915 mm], 69” [1755 mm], 90” [2285 mm]

Backup type: Tension strut, Concrete

Transition Panel(s) on which side? Left, Right, Both, None

Transitioning to: W-beam guardrail, Thrie beam guardrail, Safety shape barrier, Quad-Beam™ end shoe, Vertical face wall

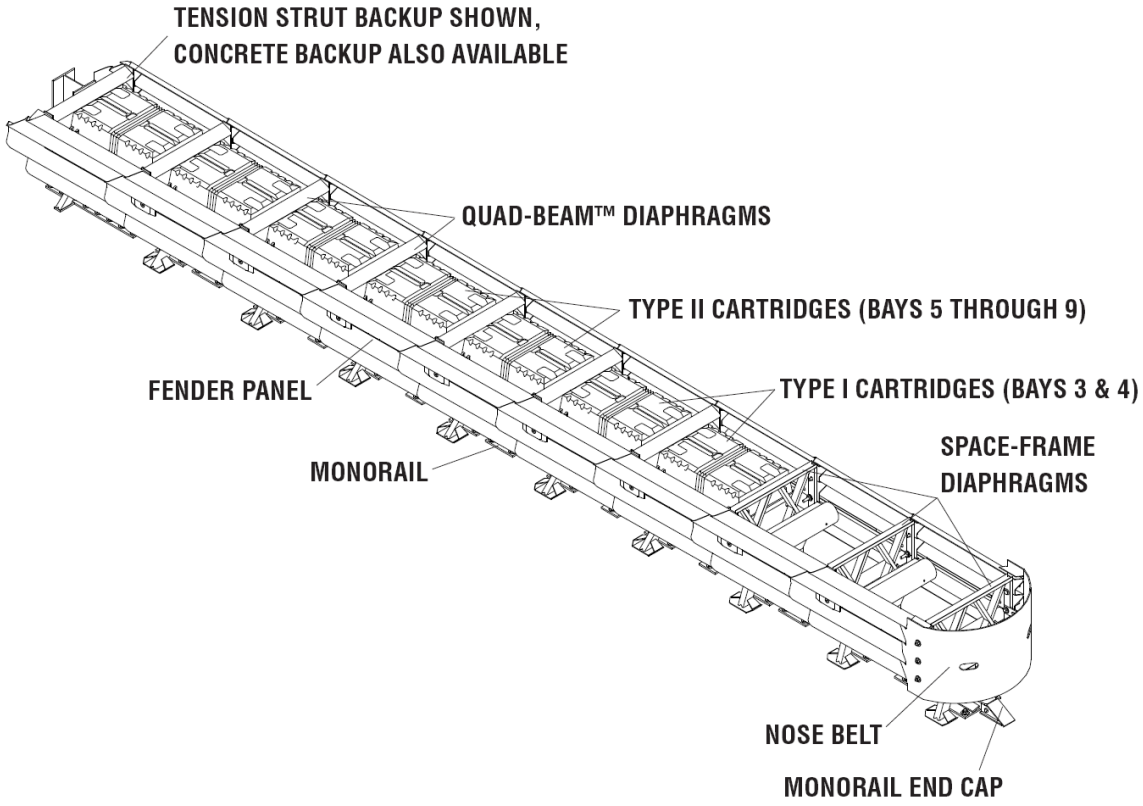


Figure 74
QuadGuard® HS for Narrow Road Features

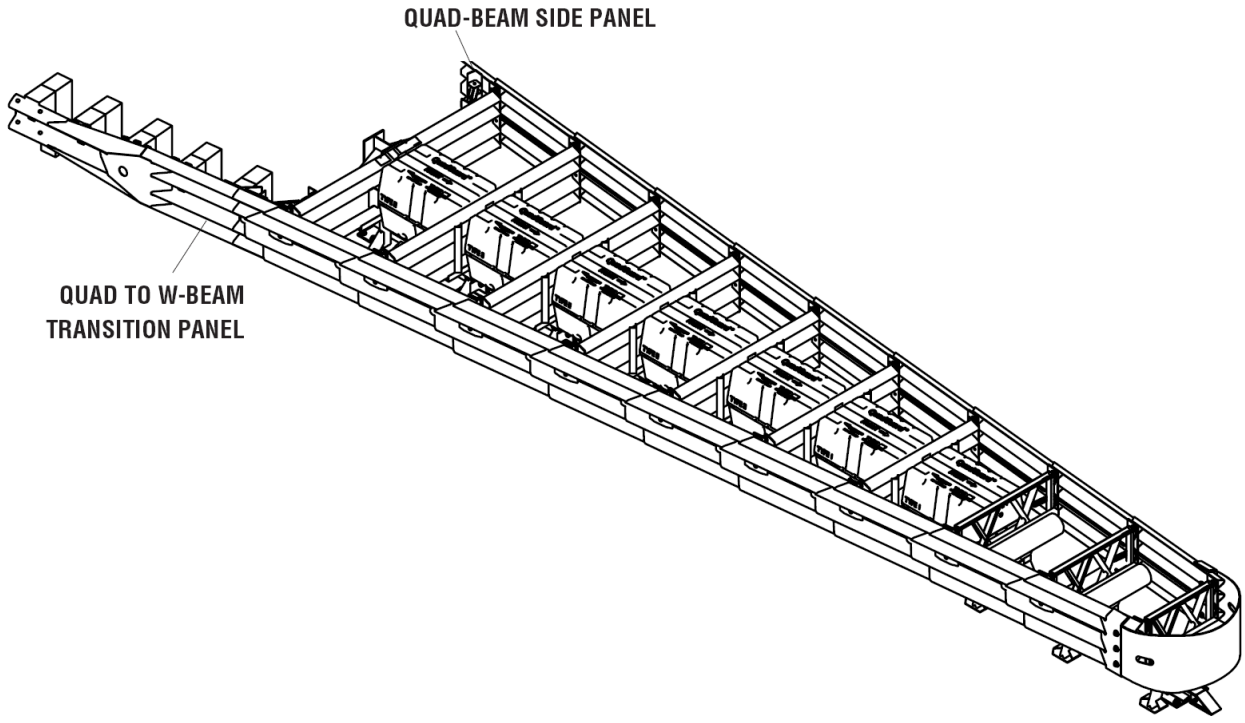


Figure 75
QuadGuard® HS for Wide Road Features

Notes:

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