

QuadGuard® CEN

CRASH CUSHIONS

ASSEMBLY MANUAL



QuadGuard® CEN

The QuadGuard® CEN was tested to meet the requirements and guidelines of the 110 kph, 100 kph, 80 kph and 50 kph performance classes using the CEN criteria described in EN 1317-3 (Crash Cushions).

Assembly Manual

Valtir, LLC



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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® CEN system. Failure to fulfill these **RESPONSIBILITIES** with respect to the assembly, maintenance, and repair of the QuadGuard® CEN system 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 International at +1 (214) 589-8140 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® CEN system information available to Valtir International at the time of printing. We reserve the right to make changes at any time. Please contact Valtir International to confirm that you are referring to the most current instructions.

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Customer Service Contacts

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

Valtir International

Telephone	USA: +1 214 589 8140 U.K.: +44 7361 864735 Singapore: +65 6276 3398 Sweden: +46 709 66 10 55
Contact Link	Valtir.com/Contact

Important Introductory Notes

Proper assembly of the QuadGuard® CEN is critical to achieve performance that has been evaluated and accepted per EN 1317-3. These instructions should be read in their entirety and understood before assembling the QuadGuard® CEN. These instructions are to be used strictly in conjunction with the assembly of the QuadGuard® CEN and are for standard assemblies only as specified by the appropriate highway authority. If you need additional information, or have questions about the QuadGuard® CEN, please contact the highway authority that has planned and specified this assembly and, if needed, contact the Valtir Customer Service Department. 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.

This manual is intended to provide guidance for new assemblies of the QuadGuard® CEN. **It is critical that the QuadGuard® CEN is placed in suitable ground/soil/foundations that will allow the system to fully perform in accordance with the design specification. Should you have any question about this, please contact the appropriate highway authority that specified the QuadGuard® CEN at a particular location for guidance. Valtir International is available for consultation with that authority.**



Important: DO NOT use any component part that has not been specifically approved for this system during the assembly or repair of this system.

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 site drawing package will be supplied by Valtir International upon request. Additional copies 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.



Important: Read safety instructions thoroughly and follow the suggested safe practices before assembling, maintaining, or repairing the QuadGuard® CEN. It is your responsibility to follow these warnings. Failure to follow warnings can result in serious injury or death to workers and/or bystanders. Please keep up-to-date instructions for later use and reference by anyone involved in the assembly of the product.



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

Safety Rules for Assembly

*** Important Safety Instructions ***

This manual must be kept in a location where it is readily available to persons who assemble, maintain, or repair the QuadGuard® CEN. Additional copies of this manual and the Product Description Manual are available from Valtir International by calling +44 7361 864735, or visiting Valtir.com/Contact. Please contact Valtir International if you have any questions concerning the information in this manual or about the QuadGuard® CEN.

Always use appropriate safety precautions when operating power equipment, mixing chemicals, and when moving heavy equipment or QuadGuard® CEN components. Safety articles including but not limited to work gloves, protective eyewear, safety-toe shoes, and back protection should be used.



Warning: Safety measures incorporating appropriate traffic control devices specified by the highway authority must be used to protect all personnel while at the assembly, maintenance, or repair site.

Safety Symbols

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

Symbol

Meaning



Safety Alert Symbol: Indicates Danger, Warning, Caution, or Important. Failure to read and follow the Danger, Warning, Caution, or Important indicators could result in serious injury or death to workers and/or bystanders.

Read all instructions before assembling, maintaining, or repairing the QuadGuard® CEN system.



Danger: 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 is no longer compliant with EN 1317-3.**



Warning: Do not assemble, maintain, or repair the QuadGuard® CEN system 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 International at +44 7361 864735 if you do not understand these instructions.



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



Important: Valtir International 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 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.



Caution: Ensure that your assembly meets all appropriate local specifications and standards. If you have any questions during the assembly of a QuadGuard® CEN at a particular assembly site, contact the specifying highway authority immediately.

Limitations and Warnings

The QuadGuard® CEN was tested to meet the requirements and guidelines of the 110km/h, 100km/h, 80km/h and 50km/h performance classes using the CEN criteria described in EN 1317-3 (Crash Cushions).

European Standard EN1317-3 tests are not intended to represent the performance of products when impacted by every vehicle type or every impact condition existing on the roadway.

Valtir International 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 International or by third parties.

The QuadGuard® CEN is intended to be assembled, delineated, and maintained in accordance with local guidelines. Valtir International offers a reflective delineator panel for its QuadGuard® CEN line of products.

Note: Consult local transportation authorities for delineation requirements.

It is important for the highway authority specifying the use of a highway product to select the most appropriate product configuration for site specifications. The customer should be careful to properly select, assemble, and maintain the product. Careful evaluation of site layout, traffic speed/type, direction, and visibility are some of the elements that require evaluation by the highway authority 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 QuadGuard® CEN should be evaluated and either restored to its original specified condition or replaced as the highway authority determines as soon as possible.

System Overview

The QuadGuard® CEN is a potentially reusable, re-directive, non-gating crash cushion for roadside features ranging in width from 610 mm to 2300 mm (24" to 90"). It consists of energy-absorbing cartridges surrounded by a framework of Quad-Beam Panels. The decision as to whether this product is reusable after impact rests within the sound discretion of the trained engineer, experienced in highway products, who is working at the direction of the local highway authority which specified and now owns the product.

Impact Performance

The QuadGuard® CEN systems have successfully passed the requirements stipulated in EN 1317-3, tests with both the light car and heavy car at speeds of up to 110 kph at angles up to 15 degrees.

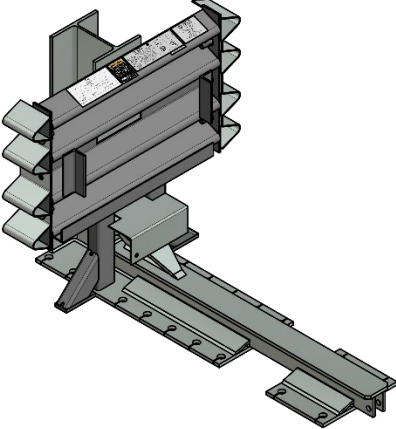
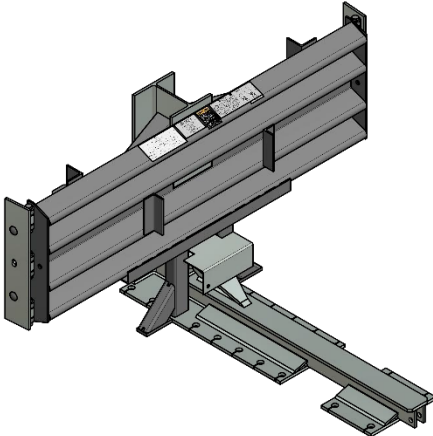
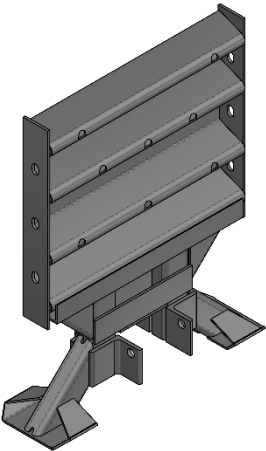
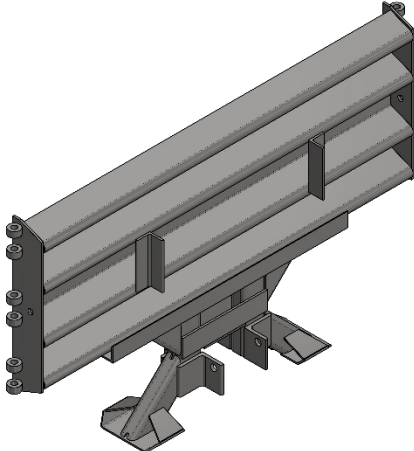
The performance level of the different models of the QuadGuard® CEN are as follows:

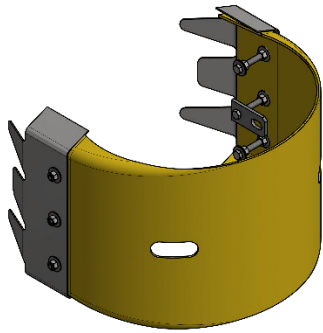
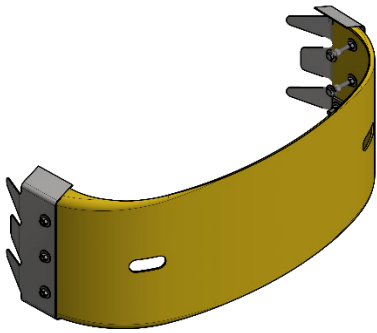

8 Bay (110 kph), 6 Bay (100 kph), 5 Bay (80 kph) and 3 Bay (50 kph)

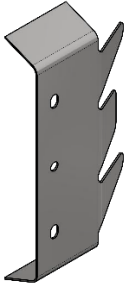
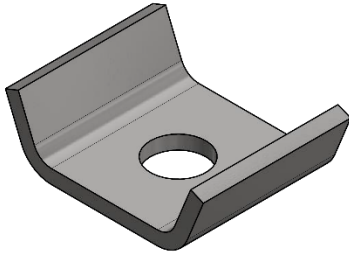

During head-on impact testing, within EN 1317-3 criteria, the QuadGuard® CEN has been shown to telescope rearward to absorb the energy of impact. When impacted from the side, within the applicable EN 1317-3 criteria has been shown to redirect the vehicle back toward its original travel path and away from the highway feature.


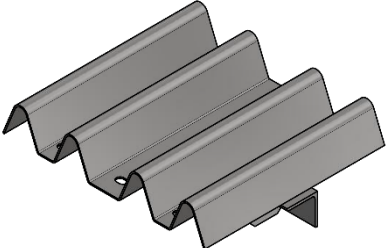
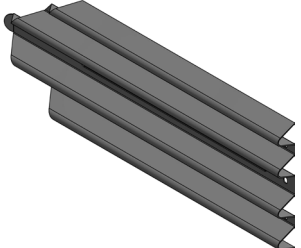
System Components (Not to Scale)

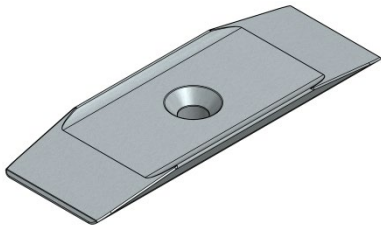
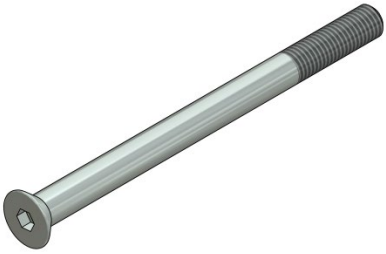

Below is a list of system components that may be used in your particular QuadGuard® CEN configuration. Verify parts delivered and system details with the BOM (Bill of Materials) and system drawings shipped with your system. Please call Customer Service if you have any system questions (p. 3).

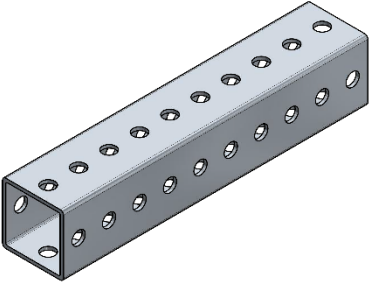
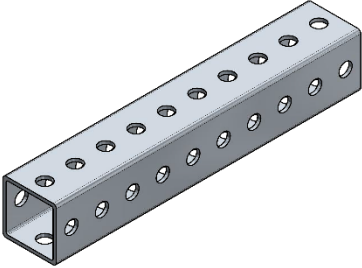
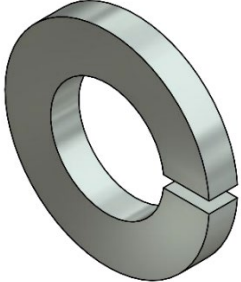

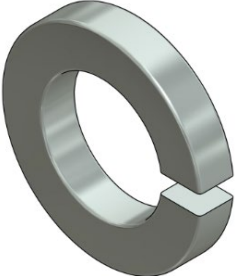

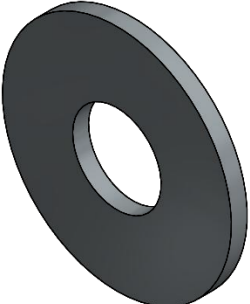
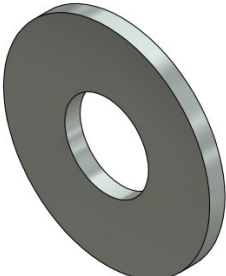
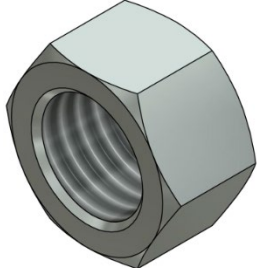
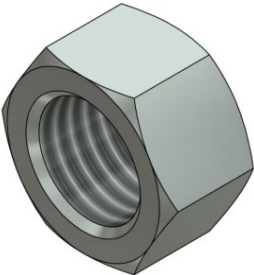
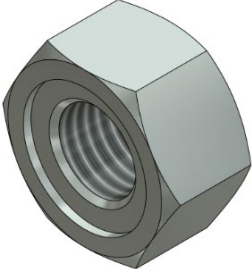
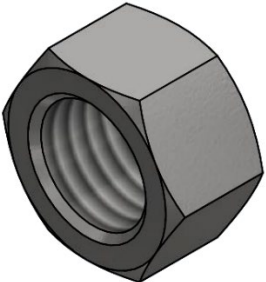
Narrow Backup Assemblies		Wide Backup Assemblies	
			
24", 30" & 36" Backup Widths		69" & 90" Backup Widths	
604573 – 24" 604576 – 30" 604587 – 36"		604597 – 64" 604600 – 83"	
Narrow Diaphragms		Wide Diaphragms	
			
Front Bays	Rear Bays	69" System	90" System
607819 – 24"	607821 – 24"	626402 – 39.08"	626401 – 32.78"
607825 – 30"	625648 – 30"	626403 – 42.23"	626402 – 39.08"
607830 – 36"	607834 – 36"	626404 – 45.38"	626404 – 45.38"
		626427 – 48.53"	626428 – 51.68"
		626428 – 51.68"	626418 – 57.98"
		626429 – 54.83"	626451 – 64.28"
		626418 – 57.98"	626420 – 70.58"
		626450 – 61.13"	626453 – 76.88"

Nose, Narrow Assembly 24, 30, 36		Nose, Wide Assembly 69 & 90	TS Cartridge Support
			
24" or 30"	36"	69" & 90"	All Backups
Gray - 611521 Yellow - 611522 Black - 611520	Gray - 611526 Yellow - 611527 Black - 611525	Gray - 611532 Yellow - 611533 Black - 611531	605447

Clamp, Nose Belt, QG	Nose Clamp Shim	Hinge Plate, Fender Panel
		
606330	614070	610172

Panel, Side, QG	Side Panel, Wide	Panel, Fender, QG
		
611898	611900	611832

Mushroom Washer	Flat Screw 5/8X8 1/2 Wide	Spring 1 1/2 OD X3/4X6 Wide
		
617045	116879	117458

Tel St 2 x 2 X 10  615765	Tel St 1 3/4 x 1 3/4 X 10  615756	Washer, Lock, 3/8  118092
Washer, Lock, 5/8  118100	Washer, Lock, 3/4  118089	Washer, Flat, 5/8X1 3/4  003300
Washer, Flat 1/2 x 1 3/8  118009	Washer, Flat, 3/4  118027	Nut, Hex, 3/8  115960
Nut, Heavy Hex, 5/8  003354	Rail Nut, Hex, 5/8  003340	Nut, Hex 1/2  115939

Nut, Heavy Hex, 3/4	Bolt, Hex 3/8 x 3 1/2 AT, G5	Bolt, Hex, 5/8 x 2 1/4, G8
		
003704	113612	113658
Bolt, Hex 5/8X5, G5	Bolt, Hex 1/2 x 2, G2	Bolt, Hex 1/2 x 3, G2
		
113667	113472	113476
Bolt, Hex 1/2 x 5	Rail Bolt, 5/8X2	Bolt, Hex 5/8 x 3 1/2, G5
		
113487	003400	113660
Bolt, Hex, 5/8X4, G5	Bolt, Hex, 3/4X2, G8	Stud, 3/4X6 1/2, G5
		
113666	113555	117540

Stud, 3/4X7, G5	Bracket, Pull-Out	Bracket, Cartridge Support
		
117542	605535	605446
Cartridge Support Bracket	1 Bay Monorail	2 Bay Monorail
		
605441	611370	611375
Monorail End Cap	Bumper Assembly, QG	Monorail Guide
		
608136	605705	611368
Locking Bar, Cart. Support	Cartridge Assy, Type E	Approved Adhesive *
		
611266	606026	619316

Foundation/Anchoring



Warning: Ensure that this assembly conforms to the guidance provided by EN 1317-3 (Crash Cushions), including, but not limited to, those regarding placement on or adjacent to curbs.

Asphalt Installations

QuadGuard® CEN Narrow systems with a Tension-Strut Backup may be 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).



Important: QuadGuard® CEN **wide** systems should not be anchored to asphalt.

Concrete Installations

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

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

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

Foundation A: Concrete Pad or Roadway

Foundation: 150 mm [6”] minimum depth 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

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® CEN system Backup and/or Monorail sections to the concrete foundation must be those shipped in the kit or of high strength steel (830 MPa [120,000 psi] minimum tensile strength or equal). These studs must be set in minimum 28 MPa [4000 psi] concrete. Allow the concrete to cure a minimum of seven days before applying anchoring adhesive.

2) Drill Boreholes



Important: Use only double-fluted drill bits with Valtir approved adhesive to achieve optimum tensile strength. Do not use diamond drill bits for anchors as the surface will be too smooth for adhesive.

Use the part that is to be anchored as a drilling template. Use a rotary hammer drill to drill the boreholes 3 mm [1/8"] larger than the stud diameter to the recommended depth. See the approved adhesive instructions provided with your kit. Check to be sure all the boreholes are drilled to the proper depth and aligned with the part to be anchored.

Anchoring Information					
Stud Size:	Orientation	Bit Size	Minimum Depth	Torque	Medium
3/4"x 6 1/2"	Horizontal	22 mm [7/8"]	133 mm [5 1/4"]	Manufacturer Spec	Concrete
3/4"x 7"	Vertical	22 mm [7/8"]	145 mm [5 3/4"]	Manufacturer Spec	Concrete
3/4"x 18"	Vertical	22 mm [7/8"]	425 mm [16 3/4"]	 15 N-m [10 ft-lb]	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 (90 psi) oil-free compressed air. Thoroughly brush the borehole with a 7/8" diameter steel bristle tube brush and then blow it out again to ensure it is completely dry and debris free.

4) Apply Approved Adhesive

Fill the borehole 100% full with adhesive material.

5) Add 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 (Figure 1).



Warning: Do not disturb or load the stud until the approved adhesive material has fully cured and consult instructions supplied with the approved adhesive kit.

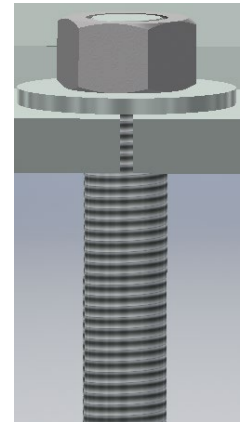


Figure 1
Anchor Application
(Before Applied Torque)

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).

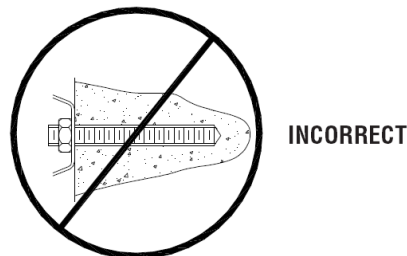
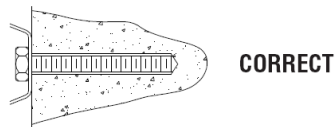


Figure 2
Horizontal Application
(Before Applied Torque)



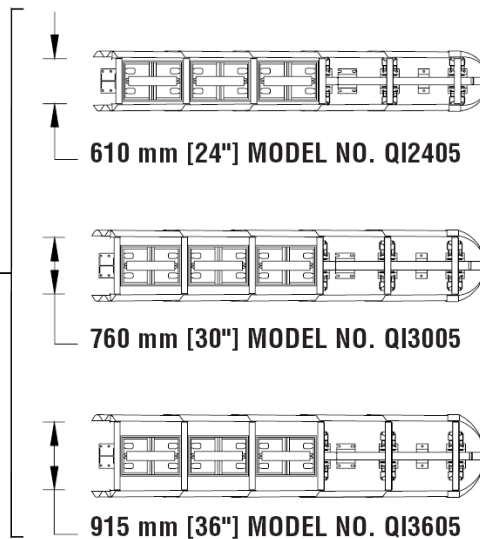
Caution: Do not disturb or load the stud until the approved adhesive material has hardened (refer to approved adhesive kit instructions for hardening times).

4) Torque the nuts

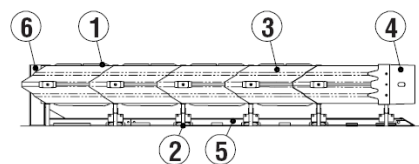
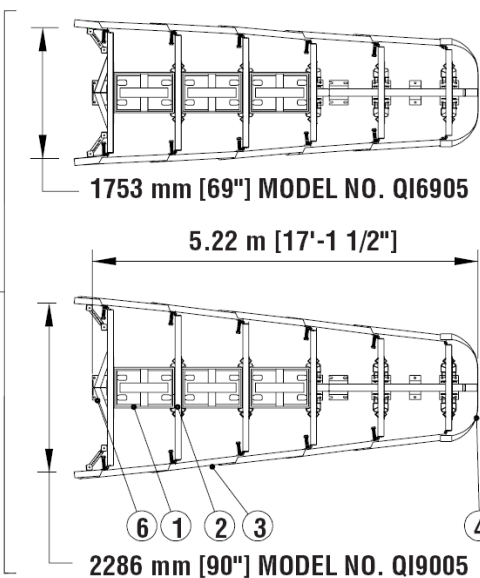
Once the adhesive has fully cured, torque nut(s) to the approved adhesive manufacturing specification.

QuadGuard® CEN

QUADGUARD CEN FOR NARROW HAZARDS



QUADGUARD CEN FOR WIDE HAZARDS



KEY

- 1) CARTRIDGE
- 2) DIAPHRAGM
- 3) FENDER PANEL ASSEMBLY
- 4) NOSE ASSEMBLY
- 5) MONORAIL
- 6) BACKUP

Plan & Elevation Views

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 (Figure 3).

Counting the Number of Bays

One bay consists of one Diaphragm, two Fender Panels, etc. The Nose Assembly is not considered a Bay. There are no Cartridges in the front two (2) bays of the system; therefore, there will be two (2) more bays than the number of Cartridges for the system. To determine number of Bays, count Fender Panels on one side (Figure 4).

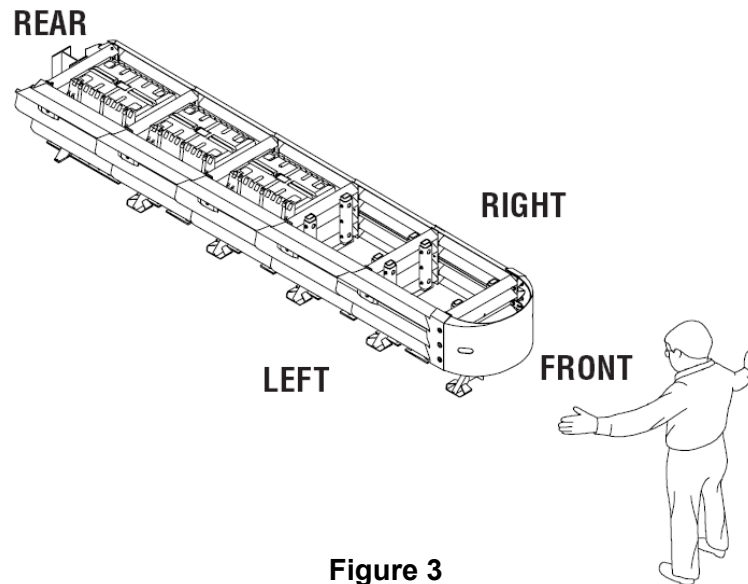


Figure 3
Left/Right

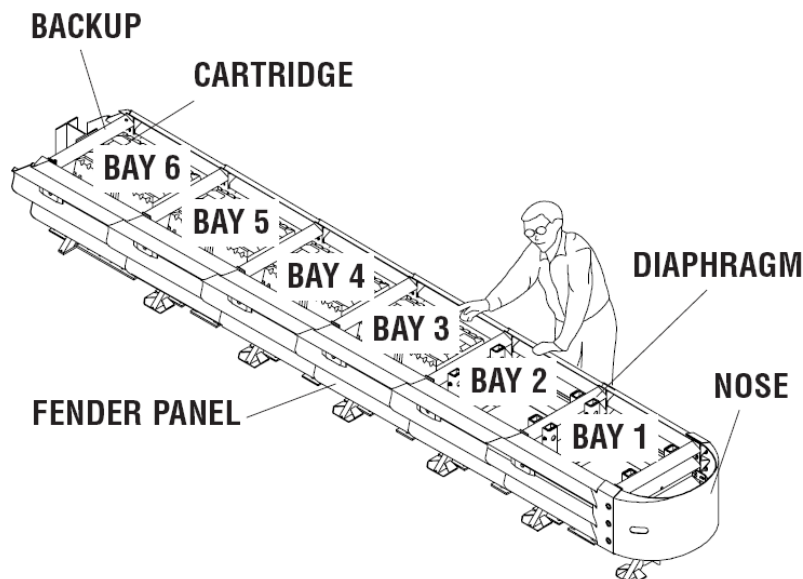


Figure 4
Number of Bays

Measuring the Width

The QuadGuard® CEN is available in five (5) nominal widths:

1. 610 mm [24"]
2. 760 mm [30"]
3. 915 mm [36"]
4. 1753 mm [69"]
5. 2286 mm [90"]

The nominal width of the system is the width between Side Panels behind the Backup (Figure 5).

The outside width of the system is approximately 150 mm to 230 mm [6" to 9"] wider than this measurement.

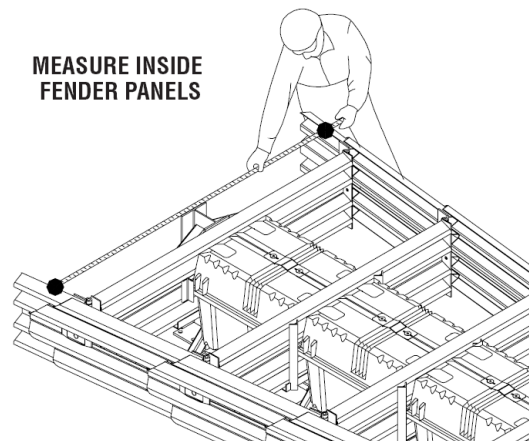


Figure 5
System Width

Assembly



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 760 mm [30"] from their pre-impact location. Position the Backup so that the rear ends of the last Fender Panels are a minimum of 760 mm [30"] forward of objects that would otherwise interfere with movement of the panels. Failure to comply with this requirement may result in impaired system performance offering motorists less protection and causing component damage.

Inspect Shipment

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



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

Recommended Tools

Documentation

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

Personal Protective equipment

- Safety Glasses
- Gloves
- Safety-Toe Shoes
- Reflective Vest
- Apron for epoxy anchors (if applicable)

Cutting equipment

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

Note: Valtir International recommends using double-fluted drill bits to achieve required tensile strength if assembling with an epoxy anchoring system.

Wrenches

- Heavy Duty Impact Wrench
- 1/2" Drive Sockets: 9/16", 11/16", 3/4", 15/16", 1 1/8", 1 1/4"
- Deep Sockets: 15/16", 1 1/4"
- Ratchet and attachments for the above sockets
- Breaker Bar: 1/2" drive x 24"
- Torque Wrench: min. 136 Nm [100 ft-lb]
- Crescent Wrench: 300 mm [12"]
- Allen Wrench: 3/8"
- Impact Wrench: 1/2"
- Pipe Wrench

Hammers

- Sledgehammer
- Standard Hammer

Miscellaneous

- Traffic Control Equipment
- Lifting and Moving Equipment (A lifting device is preferred although a forklift can be used.) Minimum 2,269 kg [5,000 lb.] capacity required.
- Air Compressor (100 psi) and Generator (5 kW)
- Long Pry-bar
- Drift Pin 300 mm [12"]
- Center Punch
- Tape Measure 7.5 m [25']
- Chalk Line
- Concrete Marking Pencil
- Steel Bottle Brush for cleaning drilled holes
- Rags, Water, and Solvent for touch-up
- Chain, 3/8" grade 40, 6 m [20'] with 13 mm [1/2"] hooks.
- Acetylene Torch



Important: The above list of tools is a general recommendation and should not be considered an extensive 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 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 assembly site.



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 (pp. 42-44).

Assembly Procedures



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



Warning: Safety measures incorporating appropriate traffic control devices specified by the highway authority must be used to protect all personnel while at the assembly, maintenance, or repair site.

1) Determine Connection Panel Type

A Connection Panel or Side Panel will be used on each side of the Backup. A Side Panel is not needed when a Connection Panel is used. Several types of Connection Panels are available for use with the QuadGuard® CEN. Refer to Figures 7 - 10 and the drawing package to determine which type of panels are being attached.



Important: The proper Connection 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 fixed object the QuadGuard® CEN is shielding. Contact the Customer Service Department prior to assembly if you have any questions (p. 3).

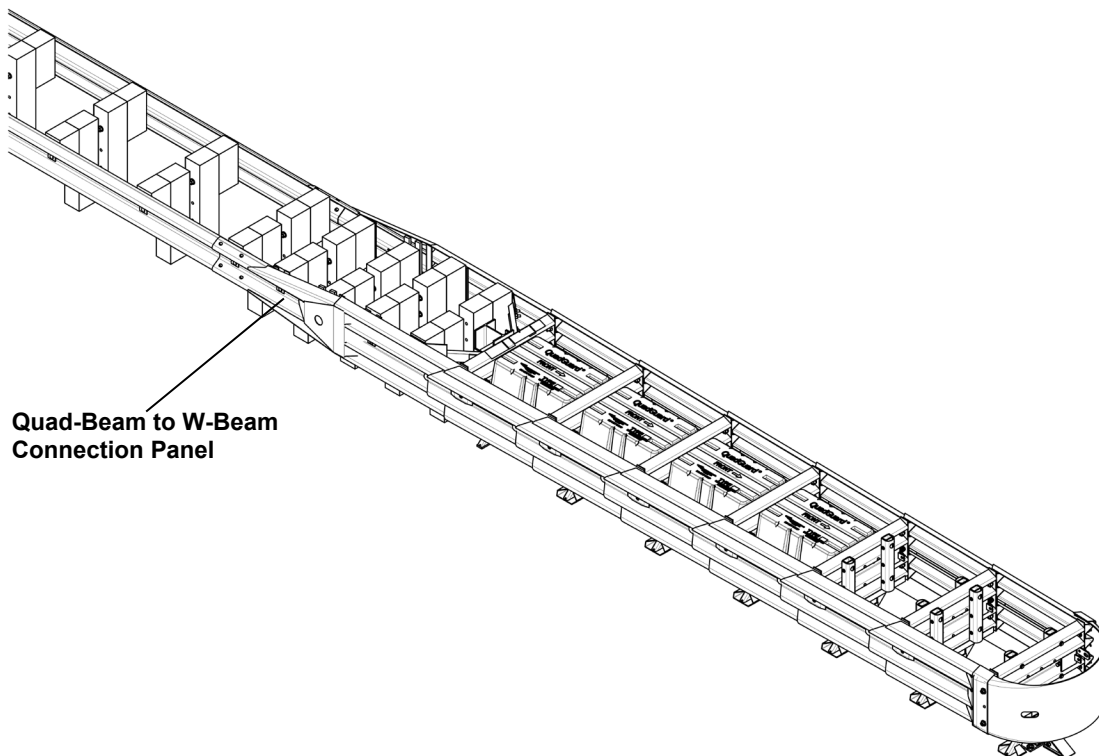


Figure 6
QuadGuard® CEN with Connection Panel

Connection Panel Types

If a system is placed in a location where traffic will be approaching from the rear of the system, a Connection Panel is necessary. Figures 7 - 10 show standard panel transition types. There are variations for each panel type. The specific panel needed will depend on system and site conditions. Therefore, it is important to send site specific data to the Valtir International Customer Service Department for a recommendation of the exact panel needed for your application.

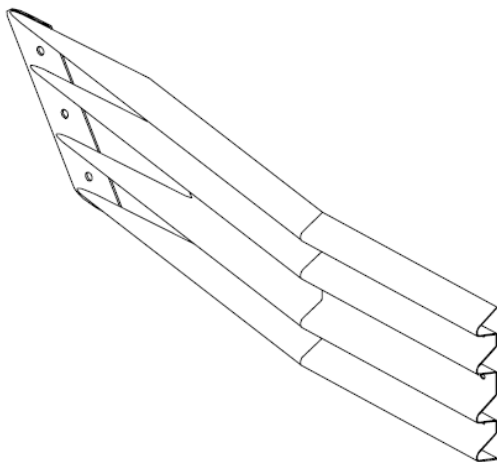


Figure 7
Quad-Beam in Safety Shape Barrier
Connection Panel

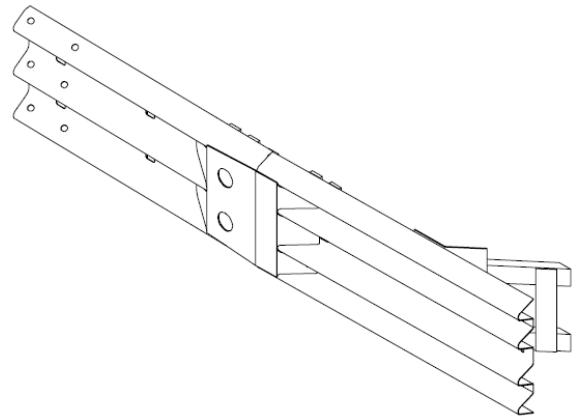


Figure 8
Quad-Beam to Thrie-Beam
Connection Panel

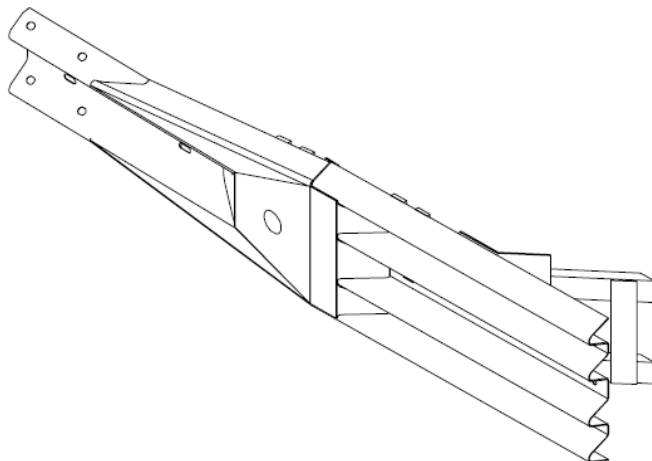


Figure 9
Quad-Beam to W-Beam Connection Panel

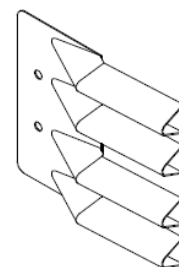


Figure 10
Quad-Beam End Shoe
Connection Panel*

***Note: Wheel Deflectors may
be required for this application.**

Anchor the System

Cross-slope of assembled location shall not exceed 8% and not vary (twist more than 2% from front to back). For these conditions, a leveling pad is required. The anchors must have a minimum pull out strength of 82.3 kN (18,500 lbs) and a minimum shear strength of 109 kN (24,500 lbs).



Warning: Ensure that there is proper site grading for QuadGuard® CEN placement as dictated by the specifying agency.

Test Parameters

The best overall measure of anchor performance is load capacity. Anchor load capacity can be defined by testing static tensile and static shear strengths. Static tensile strength is the maximum force sustained by an anchor when subjected to gradual increases in loading at the exposed end of the anchor and applied in line along its axis. Static shear strength is the maximum force sustained by an anchor when subjected to gradual increases in loading applied at the base of the exposed end of the anchor and applied perpendicular to its axis.

The tensile strength developed will be a function of the strength of the concrete or asphalt surface the anchor is placed in. Embedment depth can also affect anchor tensile strength.

Tensile test of anchors chosen should be tested in compliance with ASTM E488 – Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements (Figure 10).

Recording Test Results

Three pull tests should be conducted on site when the anchoring conditions are different from those described in the reference section of this document with the results recorded. Pictures of the testing should also be taken and stored with the recorded data.

The anchor surface is acceptable if the average of the three pulls is equal or greater than 82.3 kN (18,500 lbs).

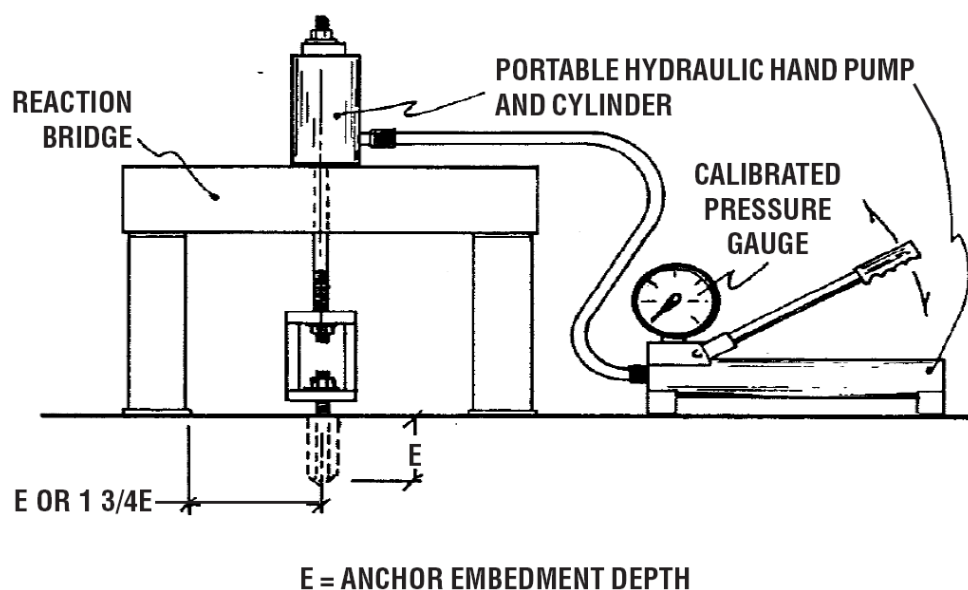


Figure 11

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 165 mm [6.5"] to one side (Figure 12). The edge of the Monorail will be placed on this line.

Note: The concrete pad shall 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 12
(Top view of concrete pad)
Locating Construction Line

2) Anchor the Backup and Monorail

See Figures 13 - 15 (showing Backup and Monorail deployment). For minimum foundation requirements, Consult the Valtir International Customer Service Department (p. 3).

Locate Tension Strut Backup and Monorail on foundation with side of Monorail on the construction line (Figure 14). Verify that any Connection Panels fit properly before anchoring Backup. Drill anchor holes in foundation using the Backup as template. Anchor the Backup to the foundation per the anchor manufacturer's instructions.

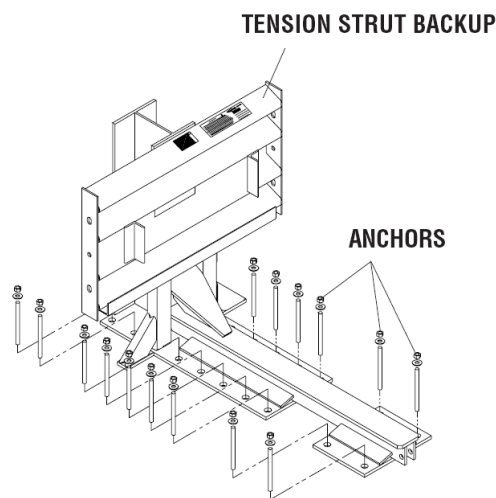


Figure 13
Anchoring Tension Strut Backup to Foundation

A) Tension Strut Backup Assembly

Locate the Backup and Monorail on the pad with the side of the Monorail on the construction line (Figure 14). Verify that applicable Connection Panels fit properly before anchoring Backup. Drill anchor holes to appropriate depth in the pad using the Backup as a template. Do not drill through foundation. Anchor the Backup to the foundation per the anchor manufacturer's instructions.

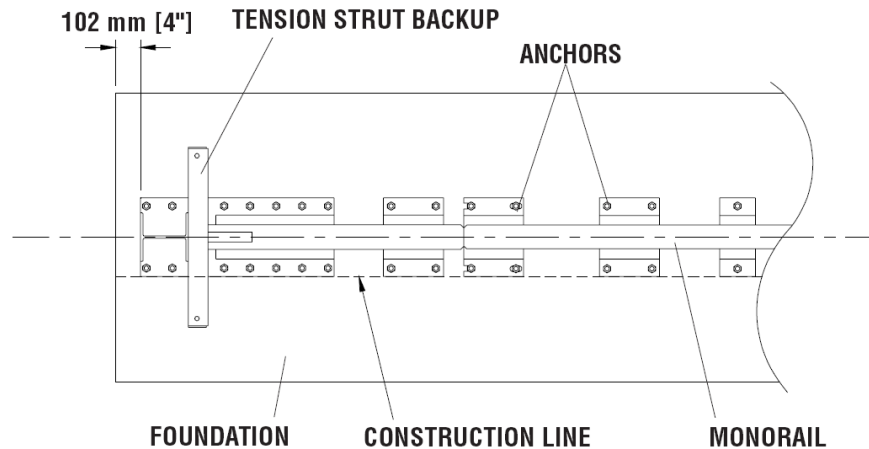


Figure 14
Anchoring the System

B) Monorail Assembly

Locate the Monorail using the Monorail Assembly drawings. Drill anchor holes to appropriate depth using the Monorail as a template (Figure 14). Do not drill through foundation. Anchor each Monorail section per the anchor manufacturer's instructions. It is important to attach each segment of Monorail in alignment from the back to the front of the system ($\pm 6 \text{ mm}$ [$1/4"$]).



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



Warning: Every hole and slot in Backup and Monorail must have an appropriate ground anchor attaching the Backup and Monorail to the foundation.

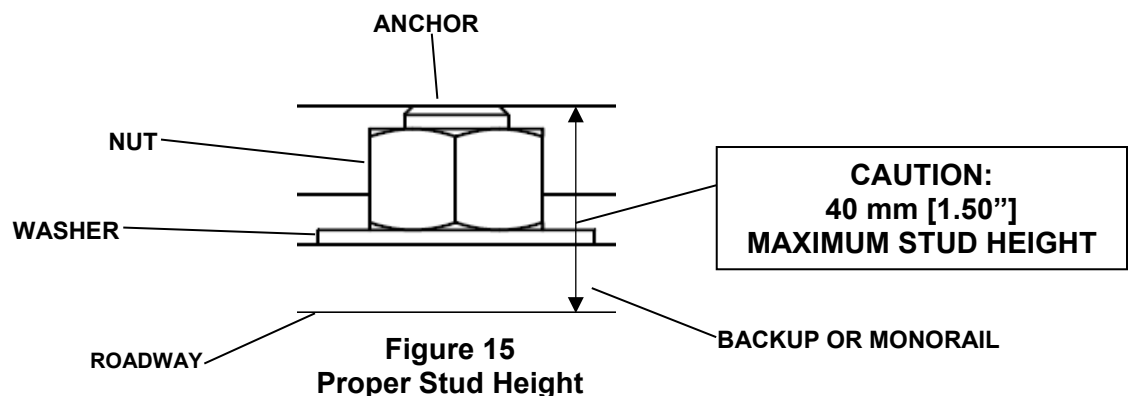


Figure 15
Proper Stud Height

3) Attach Side Panels / Connection Panels to Backup Assembly

Attach the Connection Panel or Side Panel as appropriate to each side of the Backup. See Figures 16 & 18 and the drawing package for more information.

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

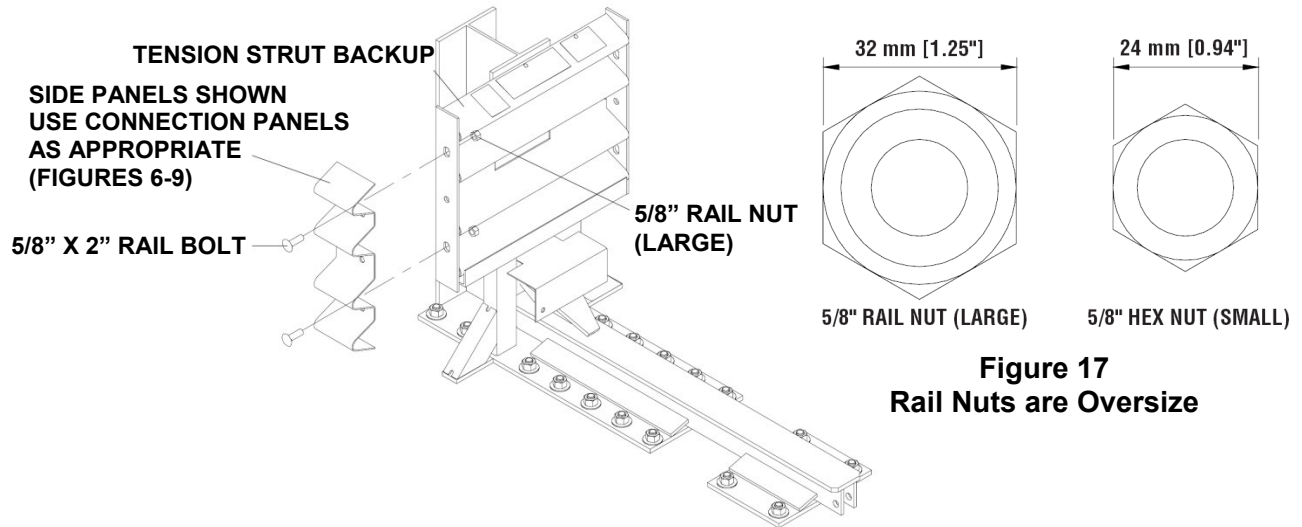


Figure 17
Rail Nuts are Oversize

Figure 16
Side Panel/Connection Panel
Attachment for **Narrow Applications**

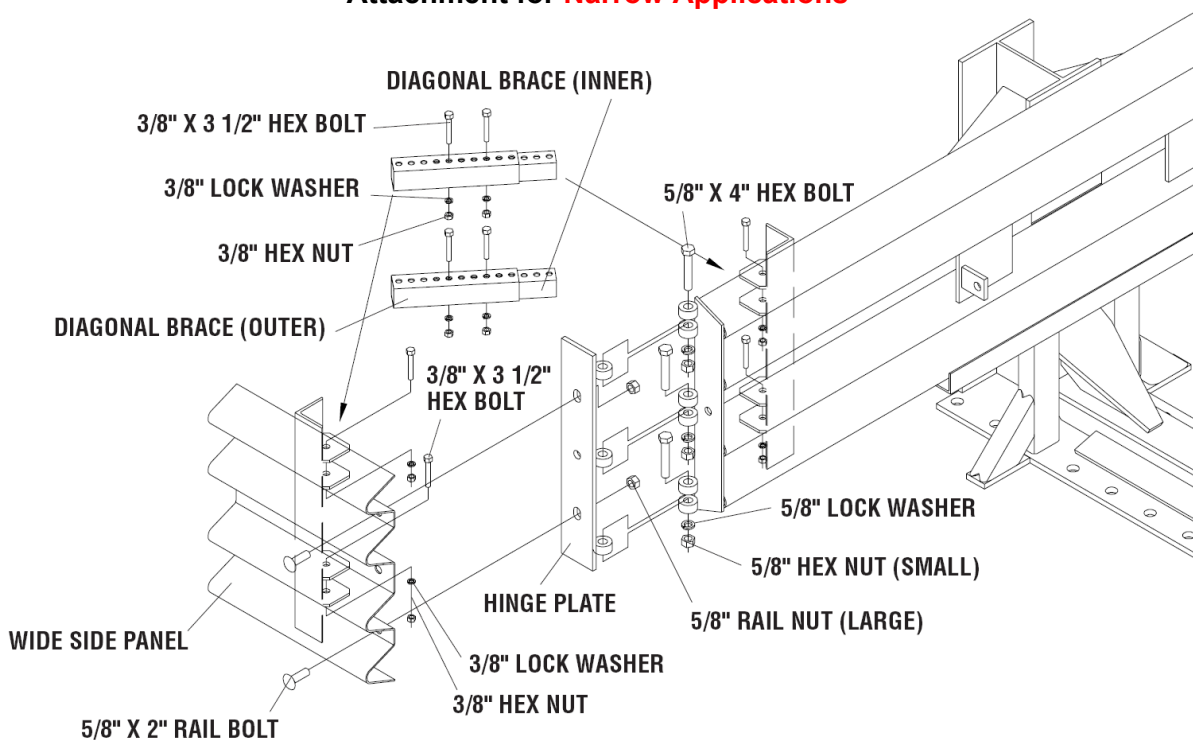


Figure 18
Side Panel/Connection Panel
Attachment for **Wide Applications**

4) Attach Monorail Guides

Attach Monorail Guides to Diaphragms as shown in Figure 19 and the Diaphragm Assembly drawing.

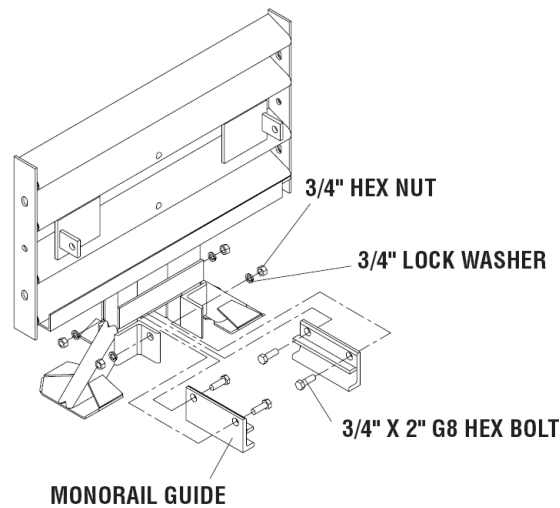


Figure 19
Monorail Guides

5) Attach Diaphragms (Narrow Systems)

Orient a Diaphragm so that the front face of the Fender Panel Assembly faces toward the nose of the system (Figure 20).



Important: Slide one Diaphragm onto the Monorail and 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 approximately 915 mm [36"] in front of the Backup (Figure 21).

Orient and slide all other Diaphragms onto the Monorail and position each as shown approximately 915 mm [36"] in front of the previous Diaphragm (Figure 21).

6) Attach Diaphragms (Wide Systems)

Orient Diaphragms so that the front face of the Fender Panel Assembly faces toward the nose of the system (Figure 20). The widest Diaphragm should be assembled closest to the Backup with each subsequent Diaphragm progressively narrower.



Important: 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 approximately 915 mm [36"] in front of the Backup (Figure 21).

Orient and slide all other Diaphragms onto the Monorail and position each as shown approximately 915 mm [36"] in front of the previous Diaphragm (Figure 21).

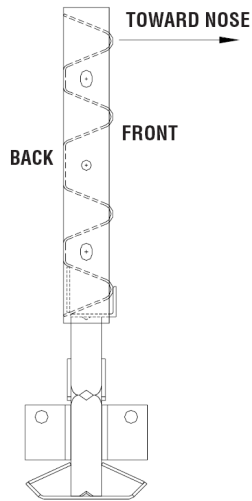


Figure 20
Diaphragm Orientation

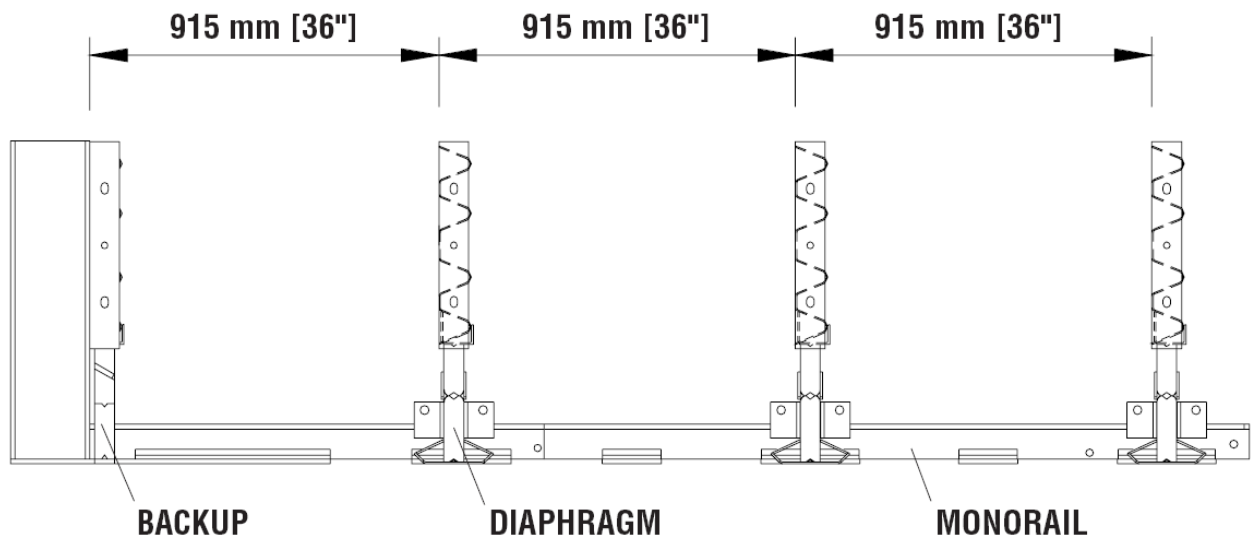


Figure 21
Initial Diaphragm Spacing

7) Attach Bumper Assemblies

Bays 1 and 2 of all systems are outfitted with Bumper Assemblies as shown in Figures 22a and 22b.

First Diaphragm

On the first Diaphragm, the Bumper Assemblies are attached to the rear of the Diaphragm only.

Attach Bumper Assemblies to the first Diaphragm by orienting each Bumper Assembly with the small holes facing the rear of the Diaphragm as shown below. Next, insert 1/2" x 5" hex bolts through the front of first Diaphragm and small hole on each Bumper Assembly. Fasten with 1/2" x 1 3/8" flat washers and nuts. Tighten all assembly fasteners to a snug position.

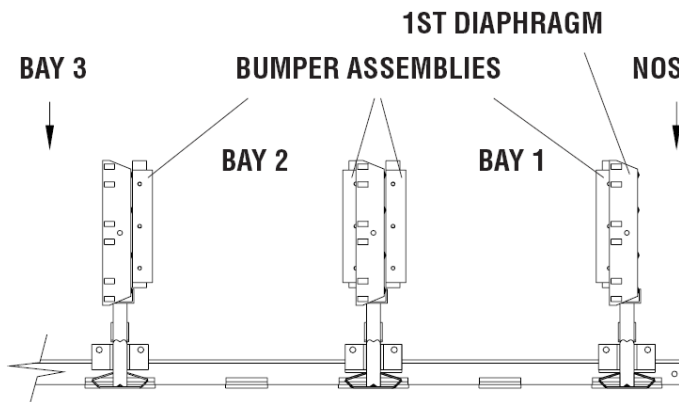


Figure 22a
Bumper Assemblies (except 3 Bay Systems)

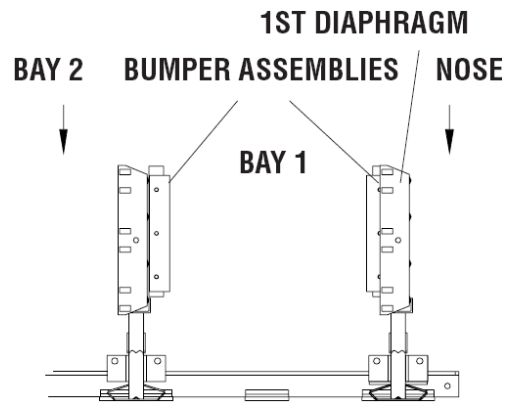


Figure 22b
Bumper Assemblies (3 Bay Systems)

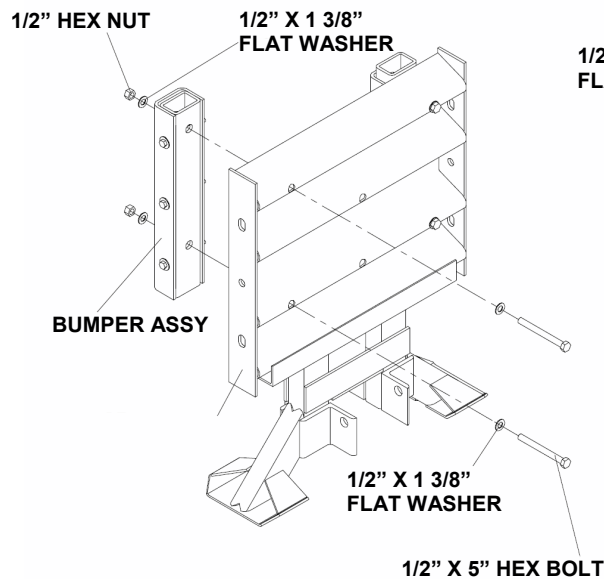


Figure 23
First Diaphragm Bumper Assembly
for Narrow Systems

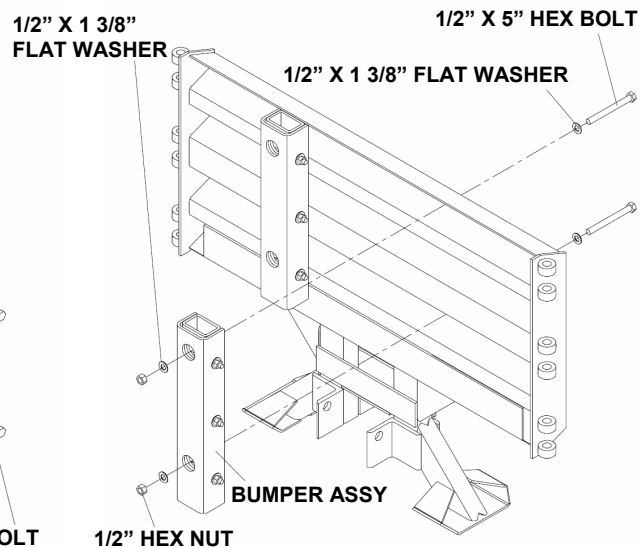


Figure 24
First Diaphragm Bumper Assembly
for Wide Systems

Second Diaphragm (*except 3 Bay Systems)

On the second Diaphragm, the Bumper Assemblies are attached to the front and rear of the Diaphragm.

Orient Bumper Assemblies front and rear with the small holes facing the second Diaphragm and fasten with 1/2" x 5" hex bolts, 1/2" x 1 3/8" flat washers, and 1/2" nuts (Figures 25 and 26). Tighten all assembly fasteners to a snug position.

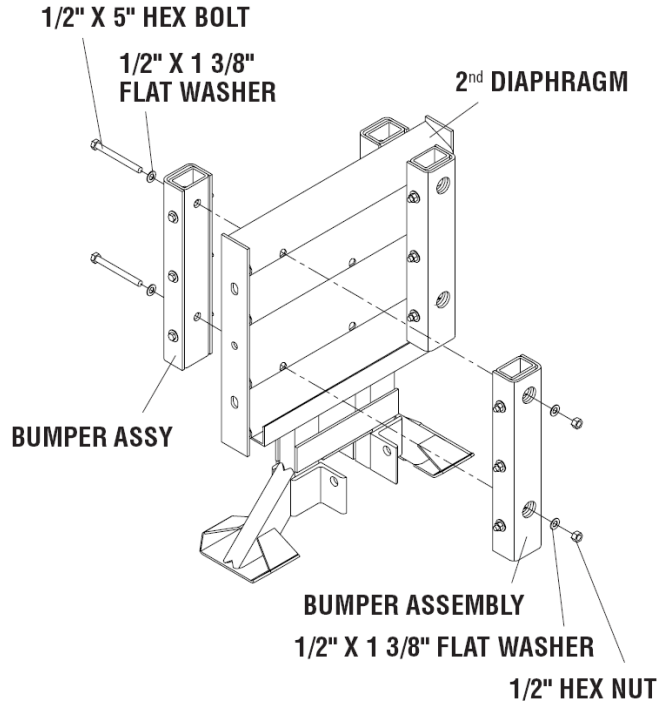


Figure 25
Second Diaphragm Bumper Assembly
for Narrow Systems

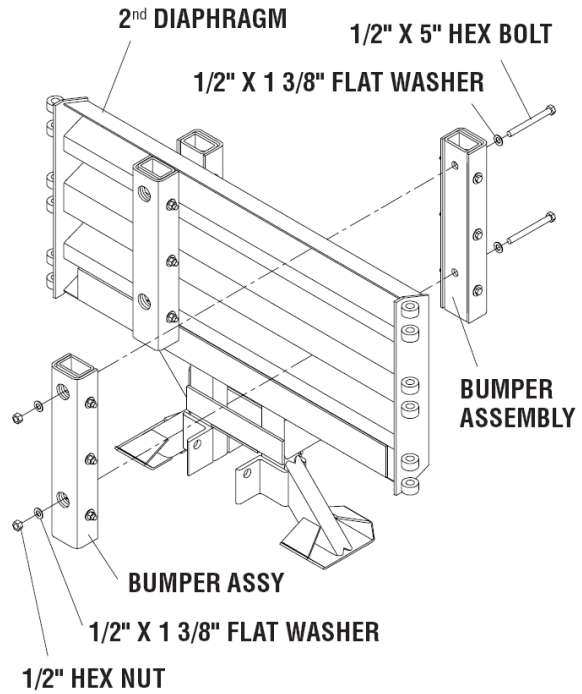


Figure 26
Second Diaphragm Bumper Assembly
for Wide Systems

Third Diaphragm

(*Second Diaphragm for 3 Bay Systems)

On the third Diaphragm*, the Bumper Assemblies are on the front side of the Diaphragm only.

Orient Bumper Assemblies with the small holes facing the front of the third Diaphragm and, using the top holes, fasten with 1/2" x 3" long hex bolts, 1/2" x 1 3/8" flat washers, and 1/2" nuts as shown in Figures 27 and 28.

The Cartridge Support Bracket and Nose Clamp Shims must be placed against the rear of the third Diaphragm and over the lower holes as shown. Fasten to the Diaphragm and Bumper Assemblies with 1/2" x 3" long hex bolts, 1/2" x 1 3/8" flat washers, and 1/2" nuts. Tighten all assembly fasteners to a snug position.

Note: This bracket is not necessary for 610 mm [24"] systems.

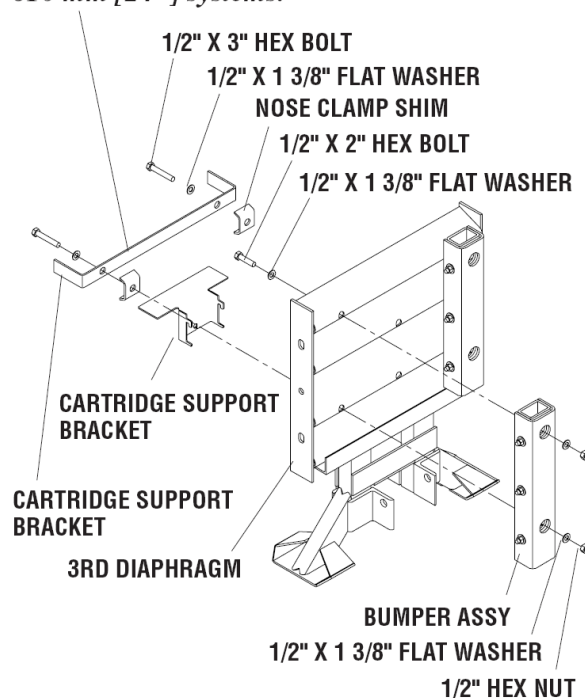


Figure 27
Third Diaphragm* Bumper Assembly
for Narrow Systems

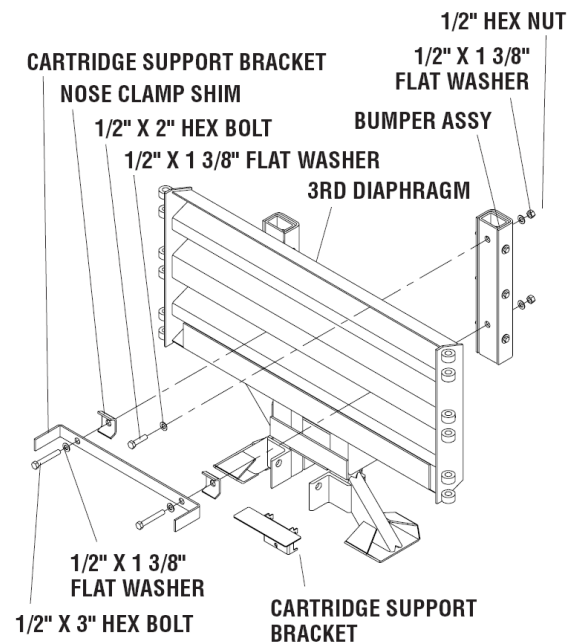


Figure 28
Third Diaphragm* Bumper Assembly
for Wide Systems

8) Attach Fender Panels (**Narrow Systems**)



Caution: Do not mix the 5/8" hex nuts (small) with the 5/8" rail nuts (large). The rail nuts are oversize (Figure 32 on p. 34).

Starting at the last bay, assemble left and right Fender Panels (Figure 28). Attach the front of each Fender Panel to the Diaphragm in front using two rail bolts and rail nuts (large) per side. Use only the top and bottom holes; leave the center hole open until the next Fender Panel is attached.

Attach Mushroom Washer Assemblies as shown in Figure 29 but do not tighten at this time.



Warning: Maximum Fender Panel gap allowed for narrow systems: 20 mm [0.78"] (Figure 31).

Note: Reference QuadGuard CEN Product Manual drawing 611302.

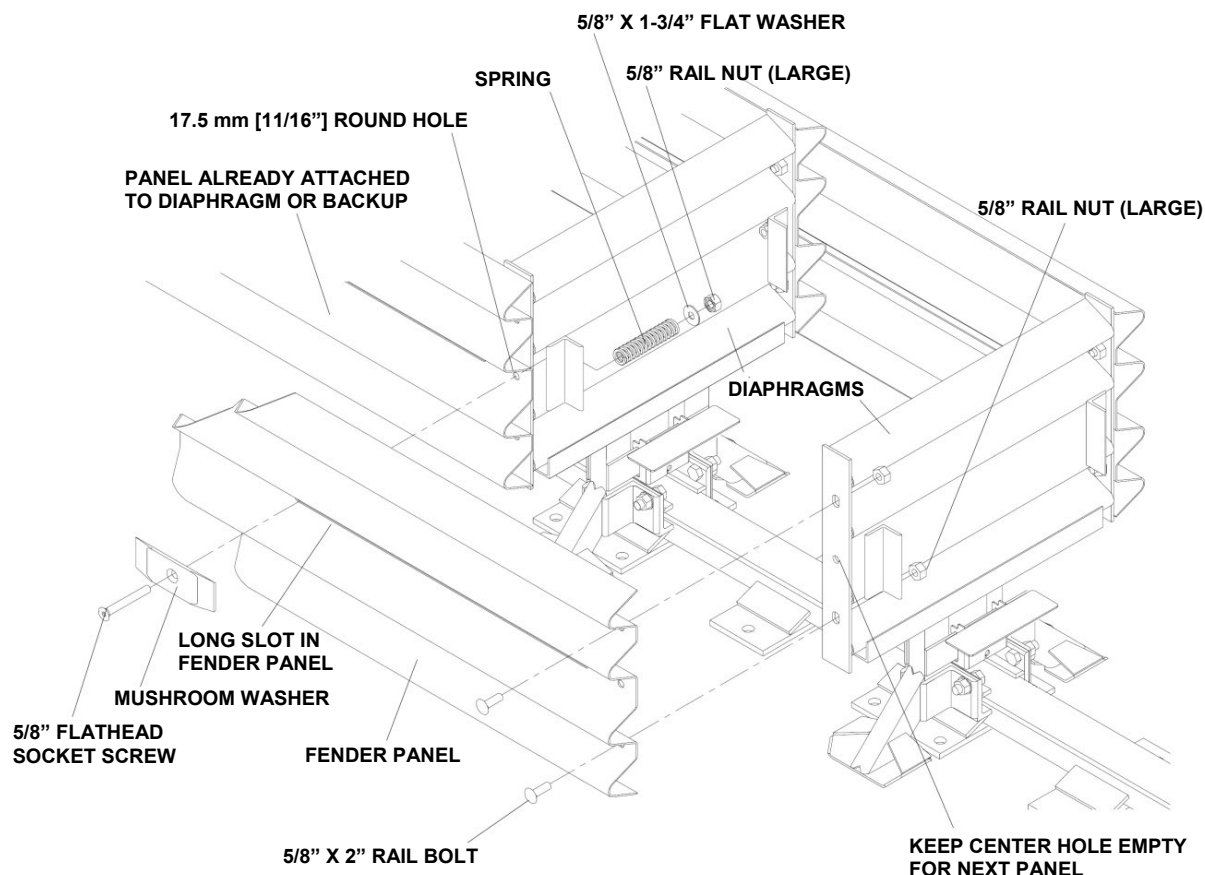


Figure 29
Fender Panel Assembly for **Narrow Systems**

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

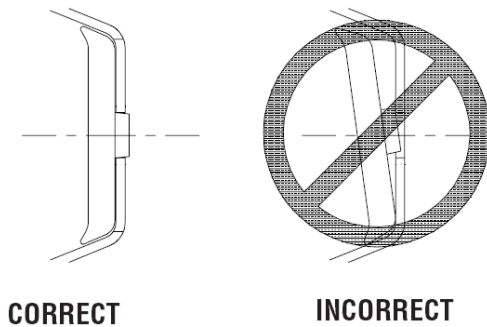


Figure 30
Mushroom Washer Orientation

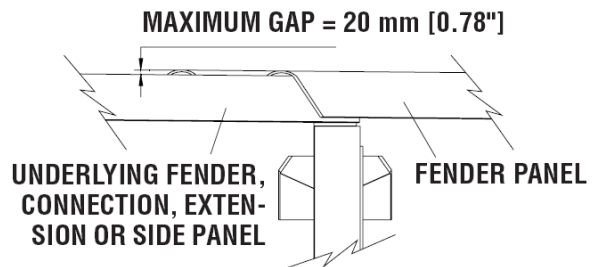


Figure 31
Fender Panel Gap for **Narrow Systems**



Caution: Do not mix the 5/8" hex nuts (small) with the 5/8" rail nuts (large). The rail nuts are oversize (Figure 32).

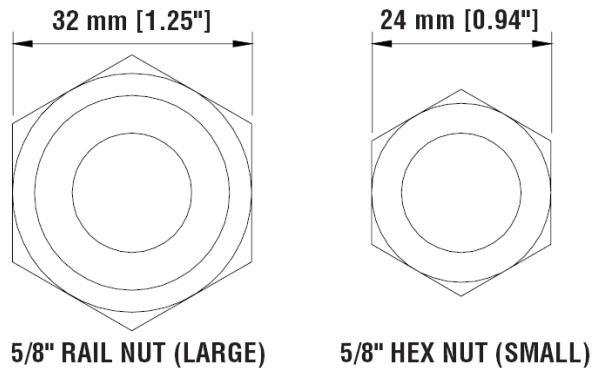


Figure 32
Rail Nuts are Oversize

9) Attach Fender Panels (**Wide Systems**)

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

Attach Hinge Plates on each Fender Panel as shown in Figure 33.

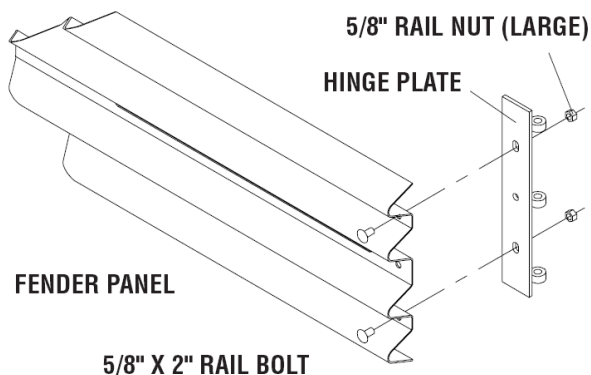


Figure 33
Fender Panel Assembly for **Wide Systems**

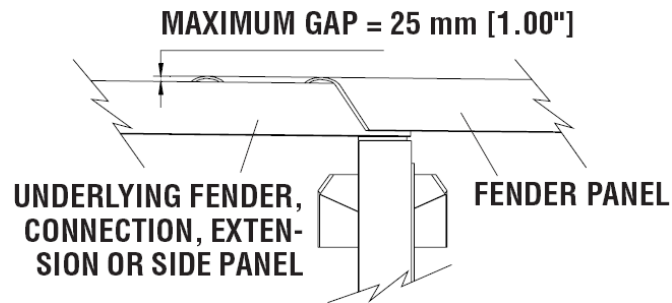


Figure 34
Fender Panel Gap for Wide Systems

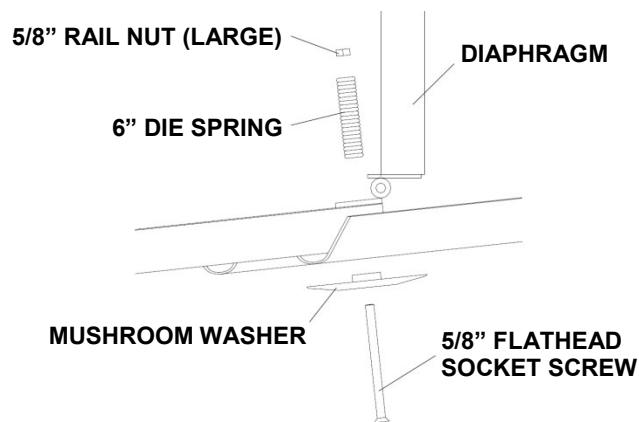


Figure 35
Mushroom Washer Attachment
Wide Systems

Starting at the last bay, attach left and right Fender Panel (Figure 36). Attach the Hinge Plate at the front of the Fender Panels to the Diaphragm in front using three (3) 5/8" hex bolts, nuts and washers.

Attach Mushroom Washer Assembly as shown in Figures 35 and 36 but do not tighten at this time.

Be sure Mushroom Washer lays flat against the Fender Panel as shown in Figure 30. Standoff on washer must be seated completely through slot.



Warning: Maximum Fender Panel gap allowed for wide systems: 25 mm [1.00"] (Figure 34).

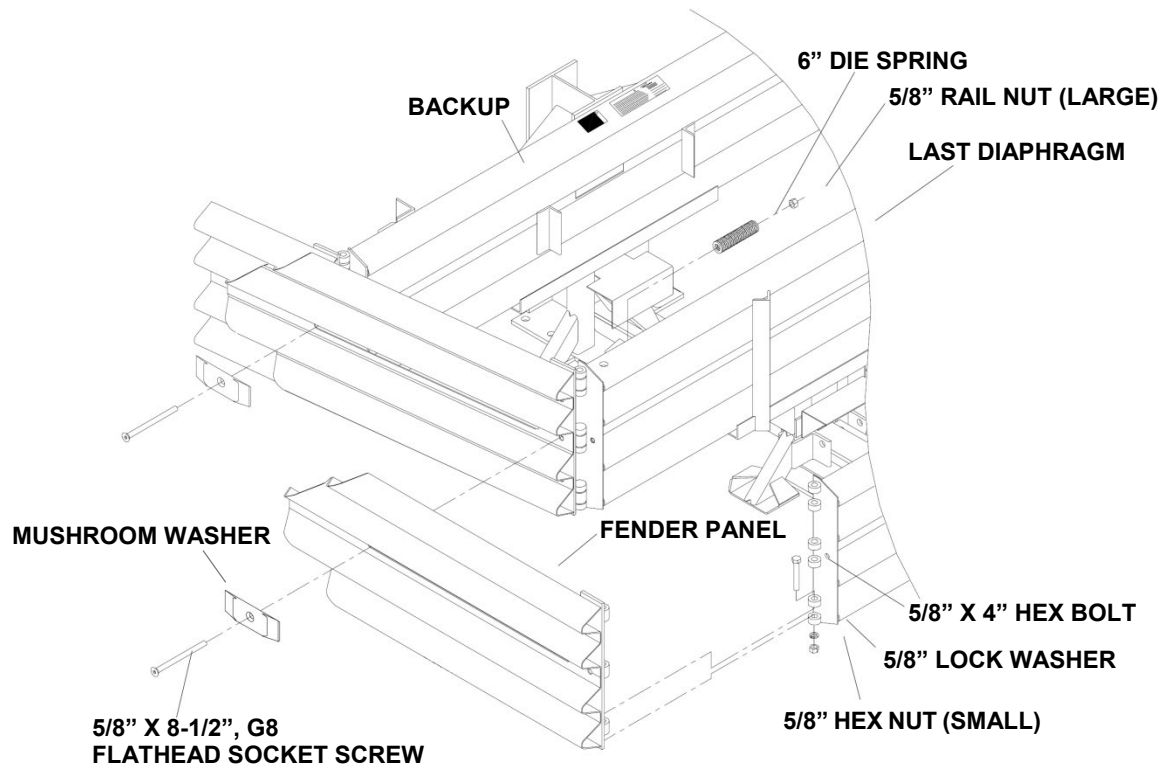


Figure 36
Fender Panel Assembly for Wide Systems

Check diaphragm spacing to ensure 915 mm [36"] between rear face of consecutive Diaphragms (Figures 37 and 38).

Once the proper spacing has been achieved, tighten the nut to compress the spring. The spring must be compressed a minimum of 1 mm and a maximum where the nut reaches the end of the bolt threads.

Attach the remaining Diaphragms and Fender Panels following the same procedure.

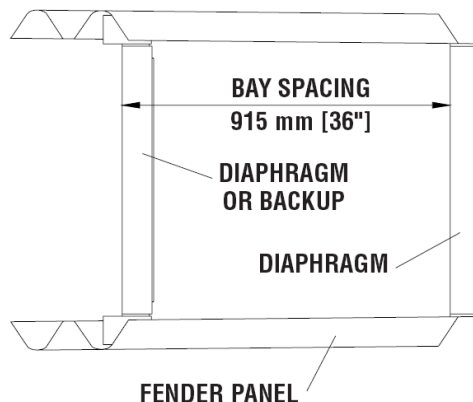


Figure 37
Proper spacing between Bays
(Narrow System shown)

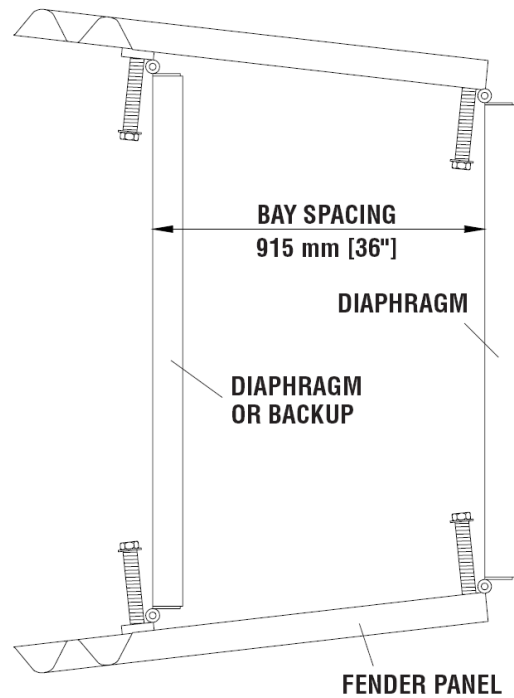


Figure 38
Proper spacing between Bays
(Wide System shown)

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 (Figure 39).

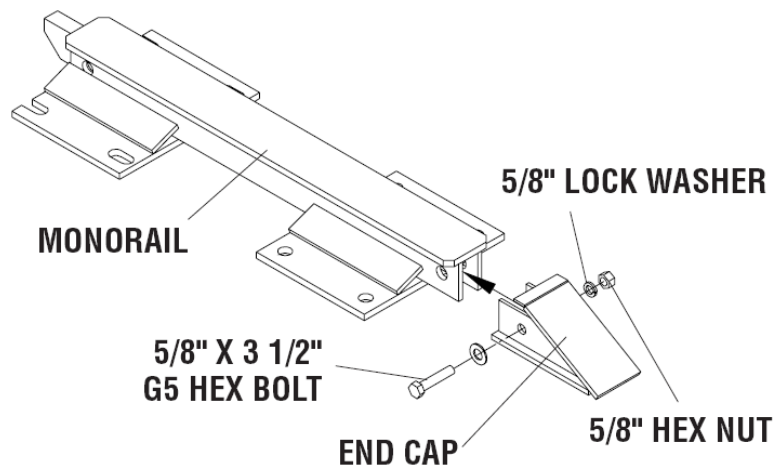


Figure 39
Monorail End Cap Attachment

11) Side Support Brackets

Note: 610 mm [24"] wide Diaphragms do not have Side Support Brackets. Only 760 mm [30"] and wider Diaphragms have Side Support Brackets welded onto the assembly.

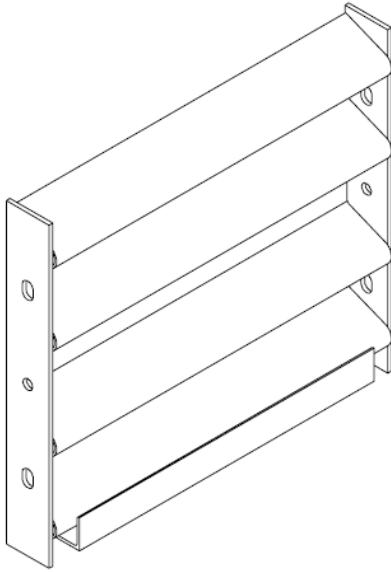


Figure 40
610 mm [24"] wide Diaphragm

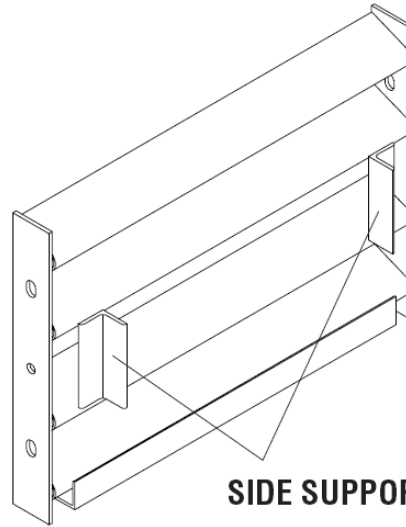


Figure 41
760 mm [30"] and 915 mm [36"]
wide Diaphragm

12) Cartridge Support Brackets

Attach Cartridge Support Bracket to Backup and all diaphragms that support Cartridges as shown in Figures 42 - 44 and the Diaphragm Assembly drawing.

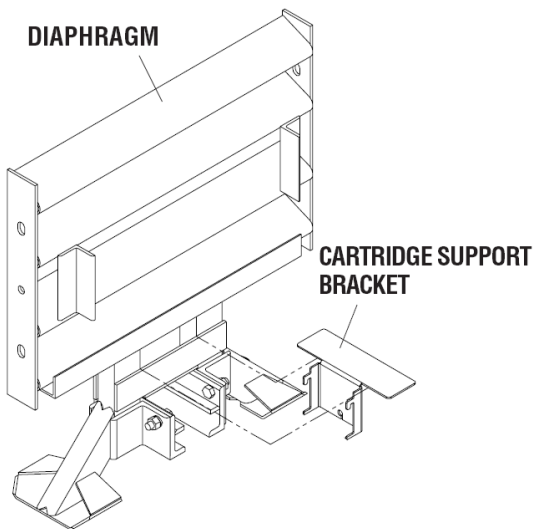


Figure 42
Cartridge Support Bracket Attachment

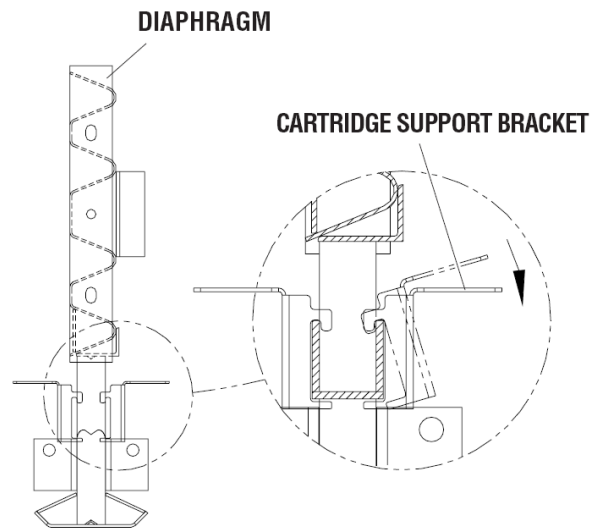


Figure 43
Cartridge Support Bracket Attachment
(Side View)

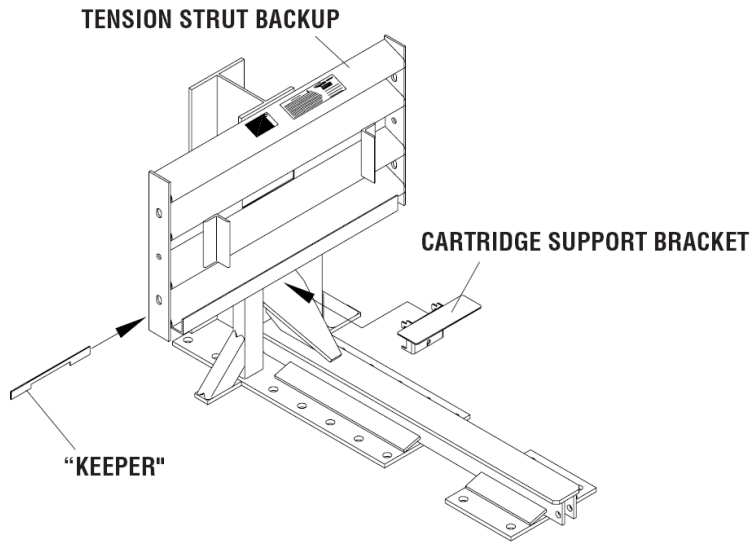


Figure 44
Cartridge Support Bracket Attachment
to Tension Strut Backup

13) Attach Nose

Attach the Nose Belt to the Fender Panels using six (6) 5/8" x 5" long hex bolts, twenty (20) 5/8" flat washers, and eighteen (18) 5/8" hex nuts through the Belt Clamps as shown in Figures 45 - 46 and the Nose Assembly drawing.

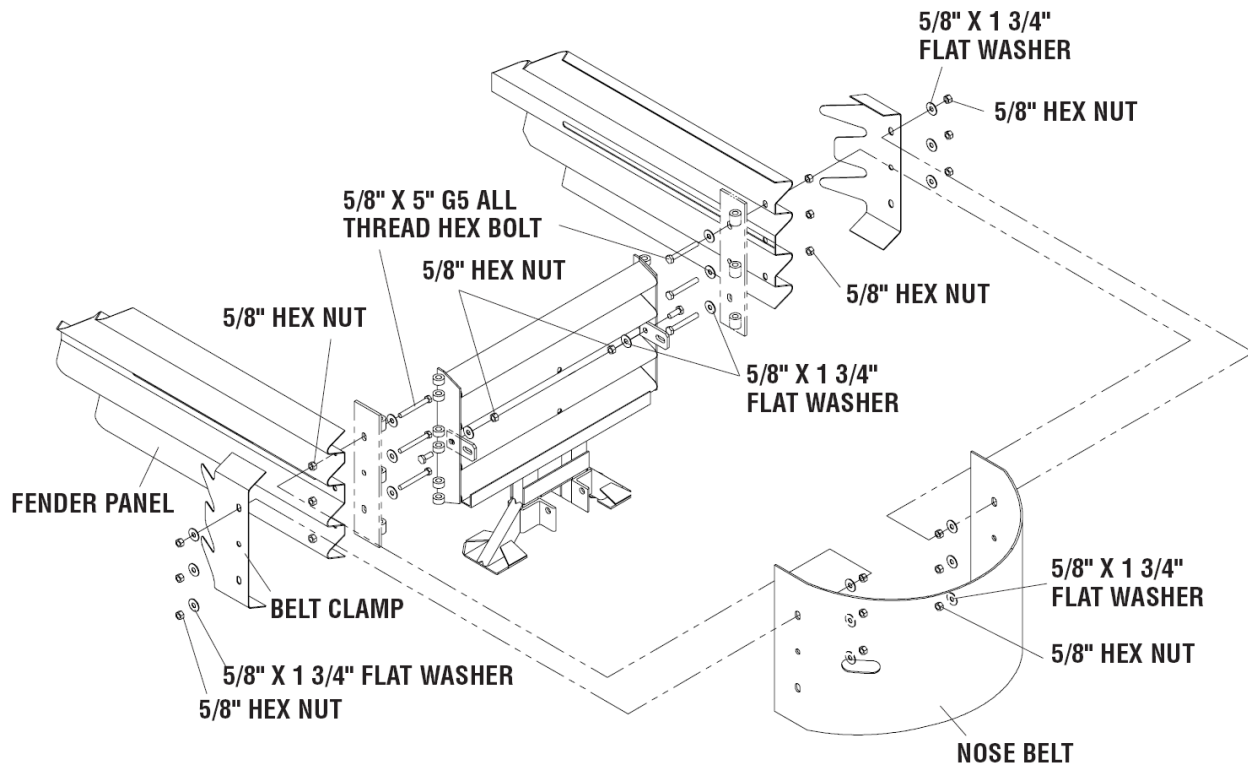


Figure 45
Nose Belt Assembly

Flat washers attach so they are flush with the outside humps of the Fender Panels (Figure 46).

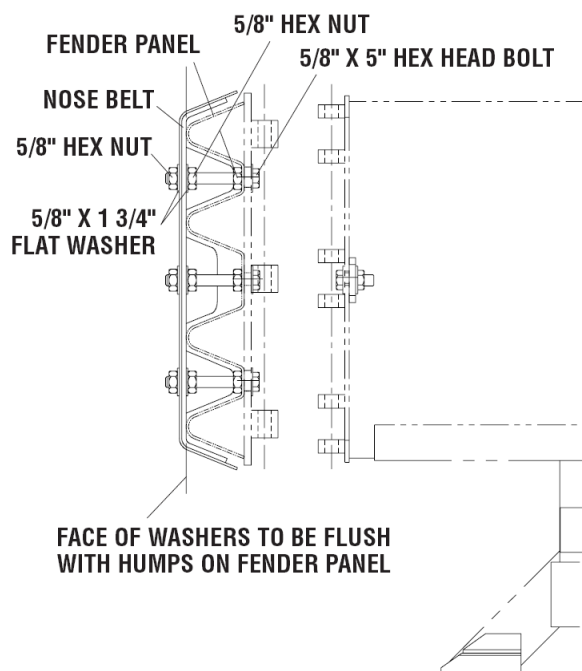


Figure 46

14) Checking the System Assembly

At this point recheck to ensure that all fasteners are properly tightened throughout the system per table below (anchor bolts, etc.). Check all Fender Panels. If they do not fit tightly against the underlying panel, system realignment may be necessary. See Figure 31 for narrow systems and Figure 34 for wide systems.



Warning	
Anchor Studs....	Torqued to 136 Nm [100 ft-lb] Shall NOT Protrude Above Nuts (Figure 15).
All Other Bolts...	Tightened
Fender Panel....	Maximum Gap Allowed
Narrow Systems	20 mm [.78"]
Wide Systems	25 mm [1.00"]

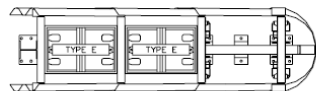
15) Cartridge Placement

To complete the assembly of a QuadGuard® CEN, place a Type E Cartridge in each Bay except the first Bay and second Bay for 5, 6, & 8 Bay systems (Figures 47 - 49).

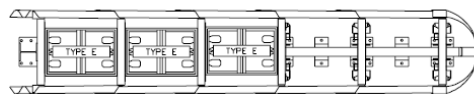


Warning: Placing Cartridges in the Nose or first Bay (and second Bay for 5, 6, & 8 Bay systems) may result in unacceptable crash performance as described in EN 1317-3.

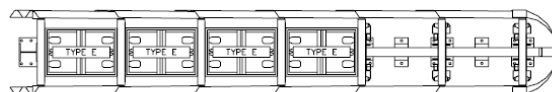
ALL CARTRIDGES ARE TYPE “E”



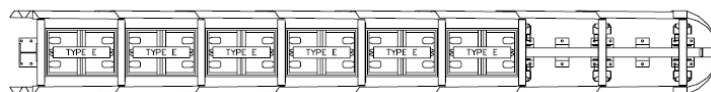
3 BAY



5 BAY

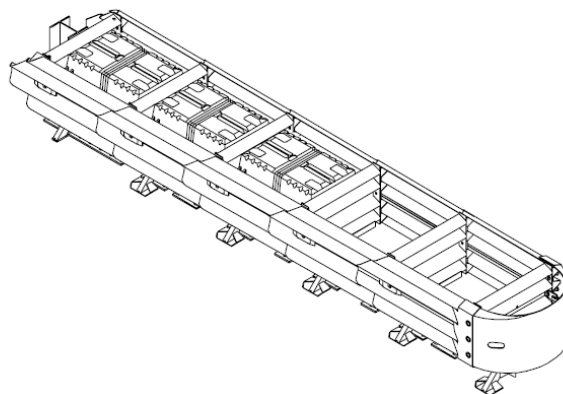


6 BAY



8 BAY

REAR



FRONT

**Figure 47
Typical Cartridge Placement**



Warning: It is the responsibility of the installer to ensure the QuadGuard® CEN system and delineation meet all local specifications.

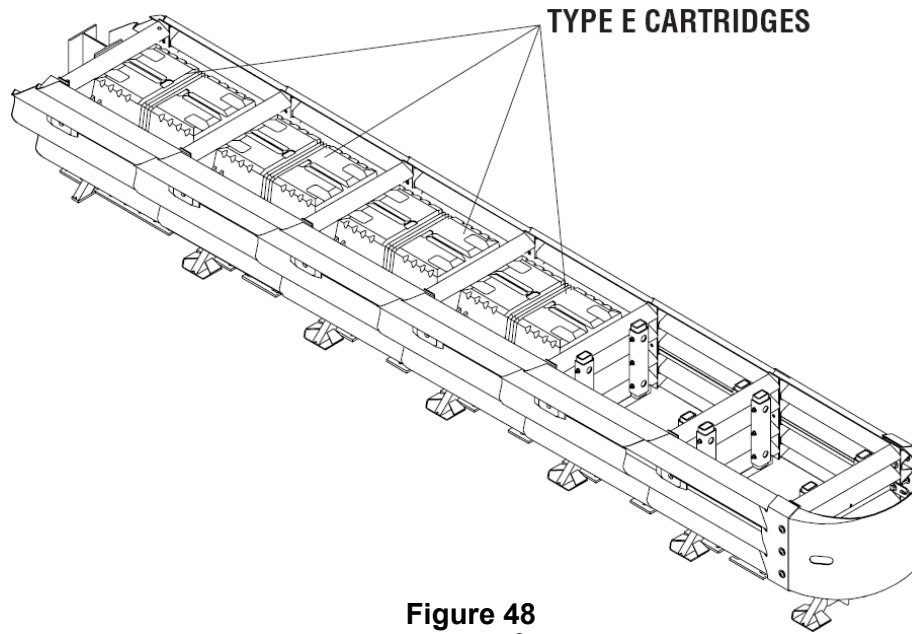


Figure 48
Completed QuadGuard® CEN for narrow
roadside obstacles (6 Bay system shown)

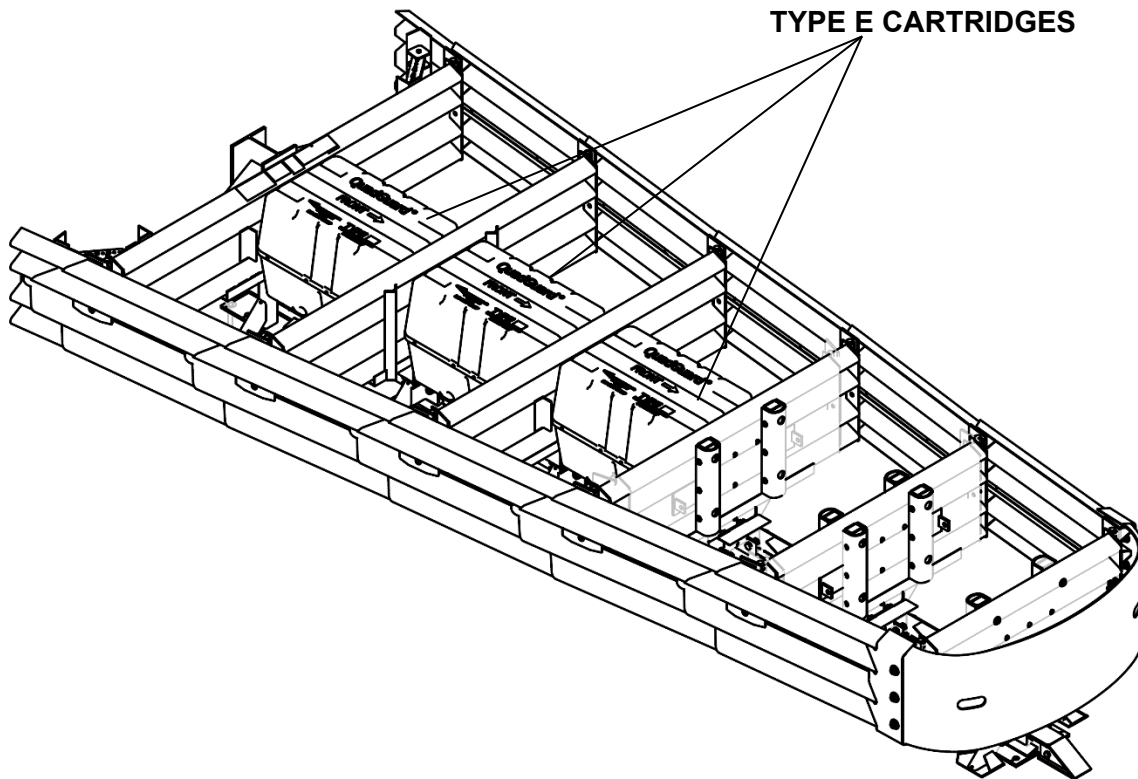


Figure 49
Completed QuadGuard® CEN for wide
roadside obstacles (5 Bay system shown)

Maintenance and Repair

The QuadGuard® CEN is considered to be a potentially reusable system. The system must be inspected after each impact and must be manually pulled out to its original length. Depending on the impact, components may get damaged and need replacement.



Important: After an impact, always follow the “Post-Impact Instructions” in the maintenance and repair section of this manual (p. 43).

Inspection Frequency

Inspections by the appropriate highway authority are recommended as needed based upon volume of traffic and impact history. Visual drive-by inspections are recommended as often as possible and at least once every month. Walk-up inspections are recommended as often as possible and at least twice a year.

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: See Cartridge placement instructions on pages 40 & 41.

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

Walk-Up Inspection

- 1) Clear and dispose of any debris on site.
- 2) Ensure all bolts are tight and rust free.
- 3) Verify concrete anchor bolts are securely anchored.
- 4) Check to ensure system Diaphragm legs are straight.
- 5) Verify all Mushroom Washer Assemblies are properly aligned and positioned (p. 34).
- 6) Fender Panels and Transition Panels should nest tightly against the system. The maximum gap allowed for narrow systems is 20 mm [0.78"] (Figure 30). For wide systems, the maximum gap allowed is 25 mm [1.0"] (Figure 34).
- 7) Ensure all 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, any partially crushed Cartridges (due to low speed impacts) should be replaced.



Warning: See Cartridge placement instructions on pages 39 - 40.

- 8) Make all necessary repairs as described above. Refer to Post-Impact Instructions for more information.
- 9) Note the location and condition of the QuadGuard® CEN 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 appropriate **traffic-control** devices.
- 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.



Warning: If the system is anchored to asphalt, it must be relocated to fresh, undisturbed asphalt after each impact to insure adequate future impact performance. The ground anchors should be deployed.



Important: The 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 site.
- 4) Check the system to ensure all Mushroom Washer Assemblies holding the Fender Panels together are still intact, properly positioned, and that the system has not been deformed in a way that would prevent pulling it back into its original position for reuse.
- 5) Ensure all Diaphragm Support Legs are properly attached to the Monorail.
- 6) Attach 10 mm [3/8"] grade 40 chain to pullout Brackets on first Diaphragm (Figure 49). Attach both ends of chain to a heavy vehicle (such as a 1 ton pickup).



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

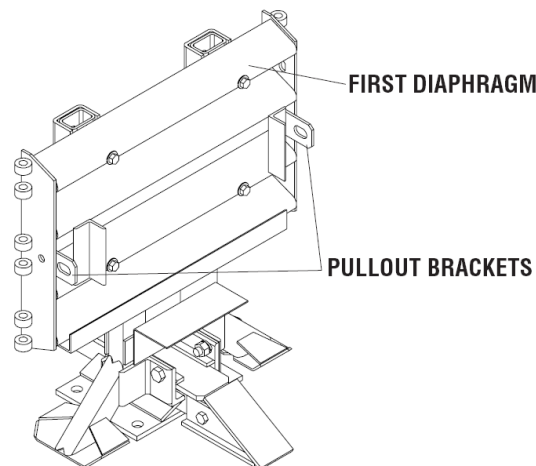


Figure 50
Pullout Bracket Locations
(Nose Belt not shown for clarity)

- 7) Pull the QuadGuard® CEN forward slowly until the system reaches its original length. Have someone watch the system during repositioning to be certain previously undetected damage does not cause the Diaphragms to bind or pull out improperly.
- 8) Remove all crushed Cartridges from within the system.
- 9) Check to see that the Diaphragms are in usable condition. Diaphragms which are bowed or have bent legs **must** be replaced.
- 10) Check that the Fender Panels are properly attached with the Mushroom Washer Assemblies. Damaged Fender Panels and Connection Panels must be replaced. Cartridge Support Brackets with minor damage can usually be straightened and reused by doing the following:
 - A. Remove damaged Cartridge Support Bracket from Diaphragm.
 - B. Clamp Cartridge Support Bracket to Backup and begin bending using pipe wrench (Figure 51).

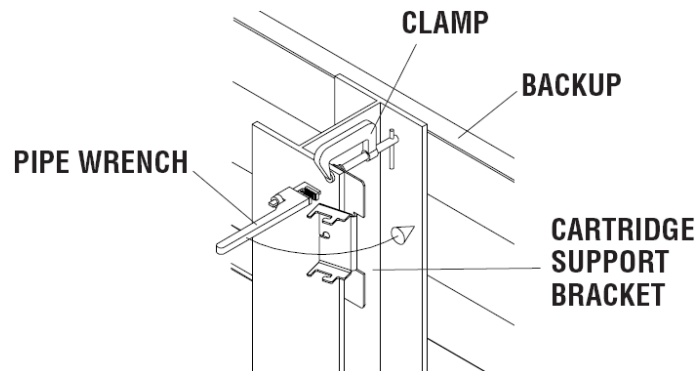


Figure 51
Straighten Cartridge Support Bracket

- C. Then, using a sledge hammer and Quad-Beam shape on Backup as an anvil, form Cartridge Support Bracket back into 90° shape (Figure 52).

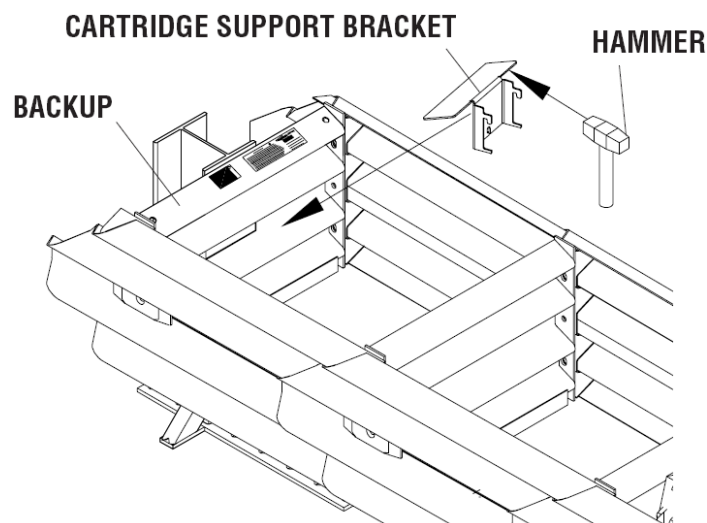


Figure 52
Form Cartridge Support Bracket

- 11) Check gaps between Fender Panels. On the bidirectional side of the system, the maximum gap allowed for these overlapping parts (including Fender Panels overlapping panels behind the system) is 20 mm [0.78"] for narrow systems and 25 mm [1.0"] for wide systems (Figure 31 & 34).

If the gaps between the Fender Panels are too large, it may be necessary to replace bent parts.

- 12) Replace all crushed Cartridges (pp. 41 & 42).

- 13) Tighten all bolts per table below.

- 14) Remove all debris from site.

- 15) The QuadGuard® CEN is ready for use.



Warning	
Anchor Studs....	Torqued to 136 Nm [100 ft-lb] Shall NOT Protrude Above Nuts (Figure 15).
All Other Bolts...	Tightened
Fender Panel....	Maximum Gap Allowed
Narrow Systems	20 mm [.78"]
Wide Systems	25 mm [1.00"]

Parts Ordering Procedure

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

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

- **System width:** 610 mm [24"], 760 mm [30"], 915 mm [36"], 1753 mm [69"], 2286 mm [90"]
- **Backup type:** Tension Strut
- **Connection Panel(s) on which side?** Left, Right, Both, None
- **Connecting to:** W-beam guardrail, Thrie beam guardrail, Safety shape barrier, Vertical face wall

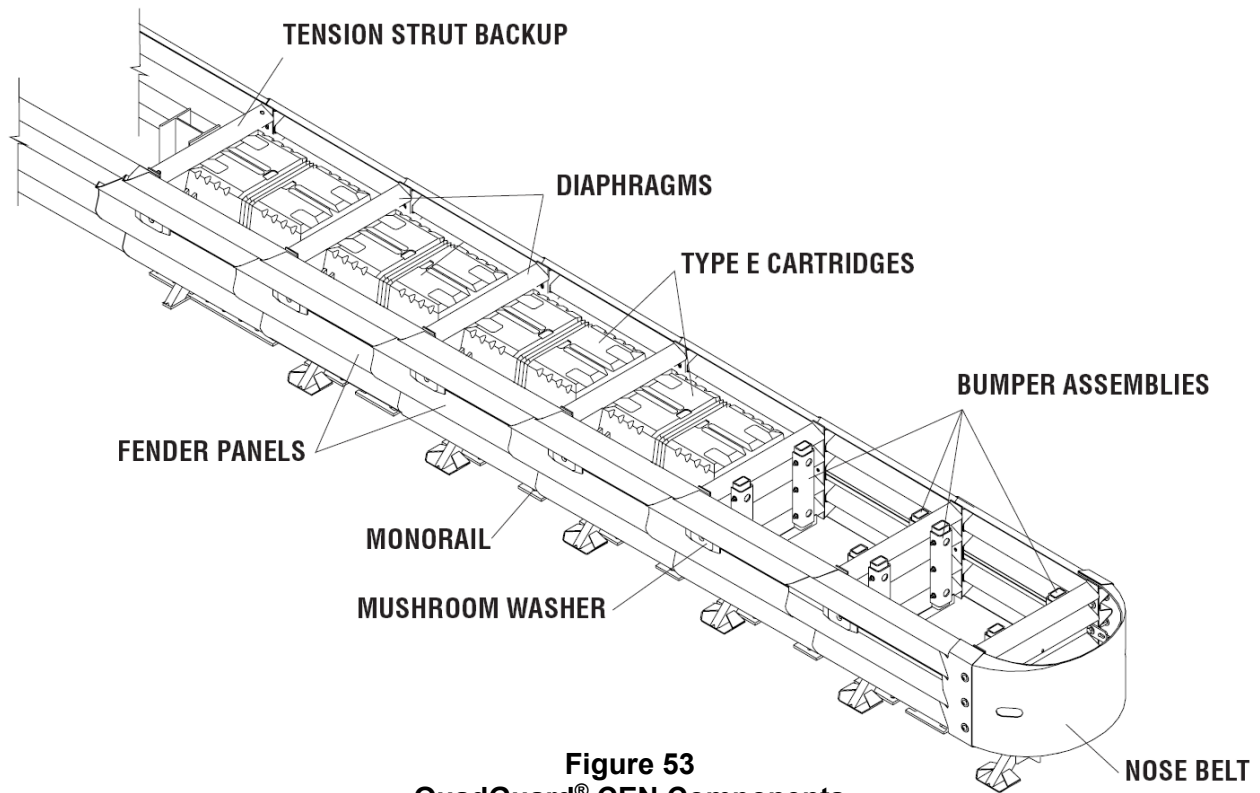


Figure 53
QuadGuard® CEN Components
(for narrow roadside obstacles)

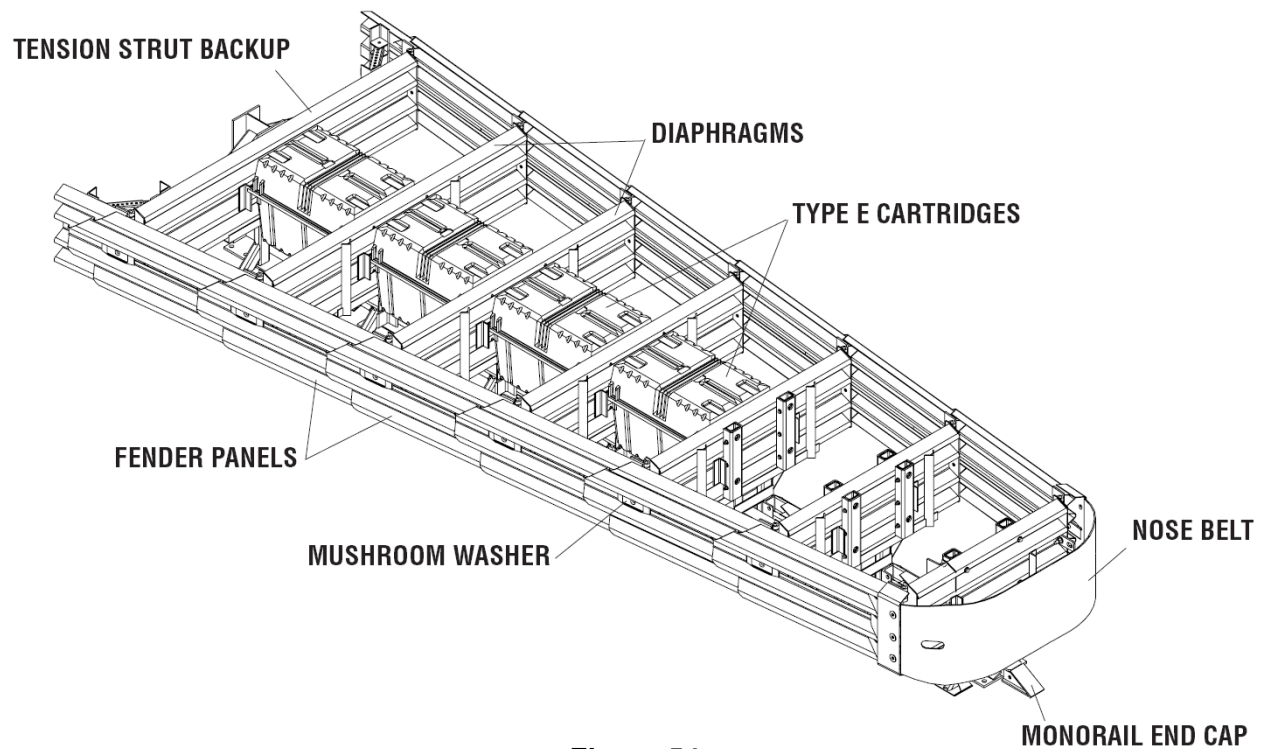


Figure 54
QuadGuard® CEN Components
(for wide roadside obstacles)



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