VALTIR

REACT 350® Narrow (36")

CRASH CUSHIONS

ASSEMBLY MANUAL

PN 115350
REVISION F NOVEMBER 2022

REACT 350®
Narrow (36”)

The REACT 350® Narrow 36” system (REACT 350® Narrow) has been tested pursuant to National Cooperative Highway Research Program (“NCHRP”) Report 350 specifications. The REACT 350® Narrow 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 REACT 350® Narrow. Failure to fulfill these RESPONSIBILITIES with respect to the assembly, maintenance, and repair of the REACT 350® Narrow could result in serious injury or death.

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

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

The instructions contained in this manual supersede all previous information and manuals. All information, illustrations, and specifications in this manual are based on the latest REACT 350® Narrow information available to Valtir at the time of printing. We reserve the right to make changes at any time. Please contact Valtir to confirm that you are referring to the most current instructions.

Part No. 115350

Table of Contents

Customer Service Contacts

Valtir is committed to the highest level of customer service. Feedback regarding the REACT 350® Narrow, 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) (214) 589-8140 (International)
Contact Link	Valtir.com/Contact

Important Introductory Notes

Proper assembly of REACT 350® Narrow is critical to achieve performance that has been evaluated and accepted by the FHWA per NCHRP Report 350. These instructions should be read in their entirety and understood before assembling the REACT 350® Narrow. These instructions are to be used only in conjunction with the assembly of the REACT 350® Narrow and are for standard assemblies only as specified by the applicable highway authority. If you need additional information, or have questions about the REACT 350® Narrow, please contact the highway authority that has planned and specified this assembly and, if needed, contact Valtir's 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 protocol 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 REACT 350® Narrow during assembly or repair. Failure to comply with these warnings could result in increased risk of serious injury or death.

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

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

Safety Symbols

This section describes the safety symbols that appear in this REACT 350® Narrow 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 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 REACT 350® Narrow. It is the responsibility of the installer to follow the instructions contained in this manual. Failure to comply with these warnings could result in increased risk of serious injury or death.
	**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 assemble, maintain, or repair the REACT 350® Narrow. Additional copies of this manual are available from Valtir by calling (888) 323-6374 or visiting Valtir.com/Contact. Please contact Valtir if you have any questions concerning the information in this manual or about the REACT 350® Narrow.

It is the responsibility of the installer to use appropriate safety precautions when operating power equipment, and when moving heavy equipment or REACT 350® Narrow components. Work gloves, apron, eye protection, safety-toe shoes, and back protection shall be used.

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

Warning: It is the responsibility of the installer to ensure that your assembly meets all appropriate Manual on Uniform Traffic Control Devices (“MUTCD”) and local standards.

Warning: It is the responsibility of the installer to ensure that the REACT 350® Narrow and delineation used meet all federal, state, specifying agency, and local specifications.

Limitations and Warnings

Valtir, in compliance with the NCHRP Report 350 “Recommended Procedures for the Safety Performance of Highway Safety Features”, contracts with FHWA approved testing facilities to perform crash tests, evaluation of tests, and submittal of results to the FHWA for review.

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

Test Level 2: 43 mph [70 km/h]

Test Level 3: 62 mph [100 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. These tests only demonstrate the occurrence of certain results following an impact within NCHRP Report 350 criteria. Every departure from the roadway is a unique event.

The REACT 350® Narrow 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 REACT 350® Narrow 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: Use only Valtir parts that are specified herein for assembling, maintaining, or repairing the REACT 350® Narrow. **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 accepted for use. Assembly, maintenance, or repairs using unspecified parts or accessories is strictly prohibited.

System Overview

The REACT 350® Narrow is a potentially reusable, re-directive, non-gating crash cushion for roadside obstacles ranging in width from 8” to 36” [203 to 914 mm].

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 REACT 350® Narrow utilizes three types of Cylinders in a “staged” configuration to address both lighter cars and heavier, high center-of-gravity vehicles. Refer to the REACT 350® Narrow Product Description Manual (PN 116513) to determine the appropriate length system for a given speed.

Impact Performance

The 4 Cylinder REACT 350® Narrow (TL-2) system has successfully passed the requirements stipulated in NCHRP Report 350, with both the light car and pickup at speeds of up to 43 mph [70 km/h] at angles up to 20 degrees.

The 9 Cylinder REACT 350® Narrow (TL-3) system has successfully passed the requirements stipulated in NCHRP Report 350, with both the light car and pickup at speeds of up to 62 mph [100 km/h] at angles up to 20 degrees.

During head-on impacts, within the above-referenced criteria, the REACT 350® Narrow travels rearward and crushes to absorb the energy of impact. When impacted from the side, within same criteria, it redirects the vehicle back toward its original travel path and away from the roadside obstacle.

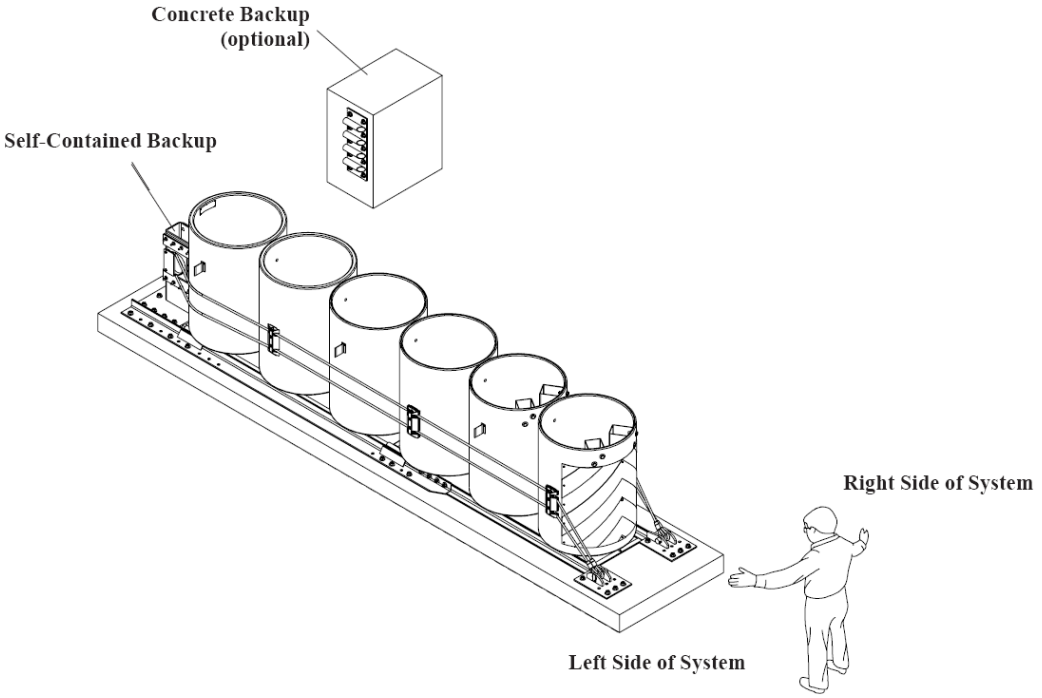


Figure 1
REACT 350® Narrow (36”) with Self-Contained Backup

Foundation/Anchoring

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

Asphalt Installations

REACT 350® Narrow systems with a Self-Contained Backup may be installed in construction zones on asphalt. Assemblies on **Asphalt Concrete ("A.C.")** must provide a minimum 3" [76 mm] layer of asphalt over a minimum 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.

Important: 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).

Concrete Installations

For concrete installations, the REACT 350® Narrow should be installed only on an existing or freshly placed and cured concrete base (4000 psi [28 MPa] minimum concrete strength). 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 in your site specific drawing package or standard drawings in the back.

The REACT 350® Narrow may be installed on any of the following foundations using the specified anchorage:

Foundation A: Concrete Pad or Roadway

Foundation: 8" [200 mm] minimum depth P.C.C.

Anchorage: Approved adhesive with 7 1/2" [190 mm] studs 6" [152 mm] embedment

Foundation B: Asphalt over P.C.C.

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

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

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

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

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

Foundation D: Asphalt

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

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

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 anchored using this system.

Important: Follow adhesive manufacturer's temperature storage requirements.

Anchor 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: It is the responsibility of the installer to maintain a safe work area including the use of standard work zone safety equipment & PPE: gloves, safety-toe shoes, and eye / ear protection.

The studs that anchor the REACT 350® Narrow 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) tensile strength. These studs must be set in minimum 4000 psi [28 MPa] concrete. Allow the concrete to cure a minimum of seven days before applying anchoring adhesive.

2) Drill Boreholes

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

Use the part that is to be anchored as a drilling template. Use a rotary hammer with a 7/8" bit to drill the boreholes 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 per table below.

Anchoring Information				
3/4" Ø Stud Length:	**Orientation**	**Concrete Bit Size**	**Minimum Depth**	**Recommended Torque**
6 1/2" & 8 1/2"	Horizontal	7/8" [22 mm]	5 3/4" [145 mm]	Consult Adhesive Kit Spec
7 1/2"	Vertical	7/8" [22 mm]	6 1/4" [160 mm]	Consult Adhesive Kit Spec
18"	Vertical	7/8" [22 mm]	16 3/4" [420 mm]	10 ft-lb [15 N-m] ⚠

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

3) Clean the Boreholes

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

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

4) Apply Approved Adhesive

Fill the borehole 100% full.

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

5) Add Nuts to Anchor Studs

Thread the nut on until flush with the end of the stud (Figure 2).

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 2).

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

7) Torque the Nuts

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

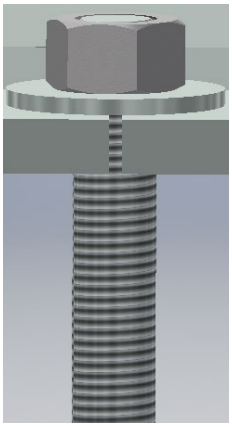


Figure 2
Anchor Application
(Before Applied Torque)

Encountering Foundation Rebar

1) Steel rebar

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

A) Using a diamond core drill bit or rebar drilling tool, drill through the rebar only, then switch back to the concrete bit and drill into the underlying concrete until the proper borehole depth is reached.

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

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

Recommended Tools

Documentation

- Manufacturer's Instructional Manual
- Manufacturer's Drawing Package

Personal protective equipment

- Eye Protection
- Gloves
- Safety-Toe Shoes
- Reflective Vest

Cutting equipment

- Grinder/Hacksaw
- Torch
- Rebar Cutting Bit
- Rotary Hammer Drill
- 7/8" [22 mm] x 7" [178 mm] Hollow Drill Bit (double fluted)

Important: Valtir recommends using **double-fluted** drill bits to achieve optimum tensile strength when applying an approved adhesive anchoring system (p. 8).

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

Hammers

- Sledgehammer

Wrenches

- Heavy duty impact wrench
- 1/4", 5/16", 3/8", 3/4", 1 7/8" Sockets
- 3/4", 1 1/16", 1 1/8", 1 1/4" Deep Hex-head Sockets
- Ratchet and extensions for above sockets
- Standard adjustable wrench
- 1 1/16", 1 1/8", 1 1/4", 9/16", 5/8", 3/4" combination wrenches
- Large Pipe Wrench

Screwdrivers

- Screw gun or standard drill with adapter chuck for small screws/bolts
- Flathead Screwdriver
- Phillips Screwdriver

Miscellaneous

- Traffic control equipment
- Lifting and moving equipment (A lifting device is preferred although a forklift can be used.) Minimum 6,000 lb. [2722 kg] capacity required. Do not lift overhead.
- Compressor (100 psi) and Generator (5 KW)
- Long pry bar
- Drift pin
- Tape measure 25’ [7.5 m]
- Chalk line
- Rags, water, and solvent for touch-up

Note: 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 the responsibility of the specifying highway authority and the authority’s selected contractor performing the assembly of the system at the authority’s specified assembly site.

Site Preparation/Foundation

Important: Check the received parts against the shipping list supplied with the system. Make sure all parts have been received.

A REACT 350® Narrow should be assembled on an existing or freshly placed and cured concrete base (4000 psi [28 MPa] minimum). Use 7 1/2" [190 mm] threaded rods attached with an approved adhesive. Location and orientation of the concrete base and attenuator must comply with project plans or as otherwise determined by the project engineer.

For an independent, soil-supported concrete foundation, include a below-grade anchor block as part of the foundation (Figure 3). The large block will keep the foundation from sliding during an impact. Additional details can be found on the standard drawings and project plans.

Recommended dimension and reinforcement specifications for new concrete foundations are provided in Valtir drawings supplied with the system. The system may be assembled on a non-reinforced concrete roadway (minimum 8" [200 mm] thick) (Figure 4).

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

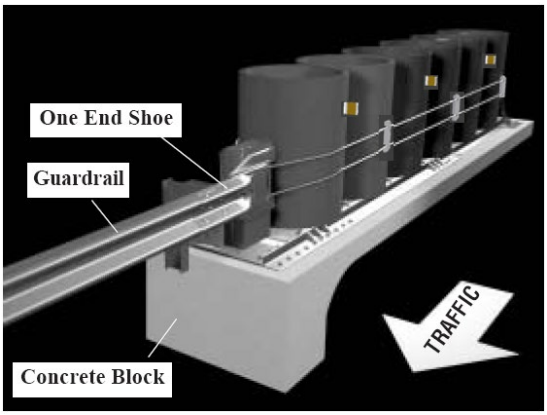


Figure 3
Permanent Construction which requires Below-Grade Anchor Block

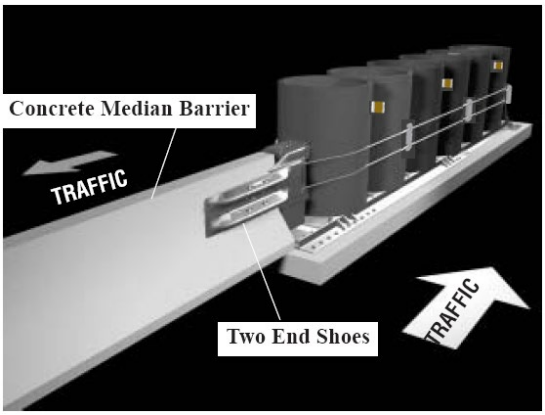


Figure 4
Permanent Construction which does not require Below-Grade Anchor Block

Warning: Do NOT modify the REACT 350® Narrow in any way.

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.

Warning: Ensure proper site grading and placement for the REACT 350® Narrow as dictated by the state or specifying agency, pursuant to FHWA acceptance.

Self-Contained Backup Assembly

Note: The Drawing Package supplied with the REACT 350® Narrow must be used with these instructions for proper assembly and should take precedence over these general instructions.

1) Deploy Traffic Control

A traffic control plan appropriate to the complexity of the project should be prepared and understood by all parties before the REACT 350® Narrow is deployed.

Deploy the appropriate work zone safety devices prior to beginning the deployment and keep them present through all phases of the assembly.

2) Determining the Basepoint and Centerline (Figure 5)

Typically the basepoint of the REACT 350® Narrow will be the midpoint of the roadside obstacle at its front face. This may change if bidirectional traffic or expansion joints are present (pp. 21 & 23).

Extend a chalk line from the basepoint, perpendicular to the roadside obstacle face, or as determined by the project engineer to a distance greater than the maximum length of the REACT 350® Narrow (refer to the drawings provided). This chalk line will become the centerline for the REACT 350® Narrow (Figure 5).

Note that the REACT 350® Narrow, when properly deployed, appears to be an extension of the object which it is shielding.

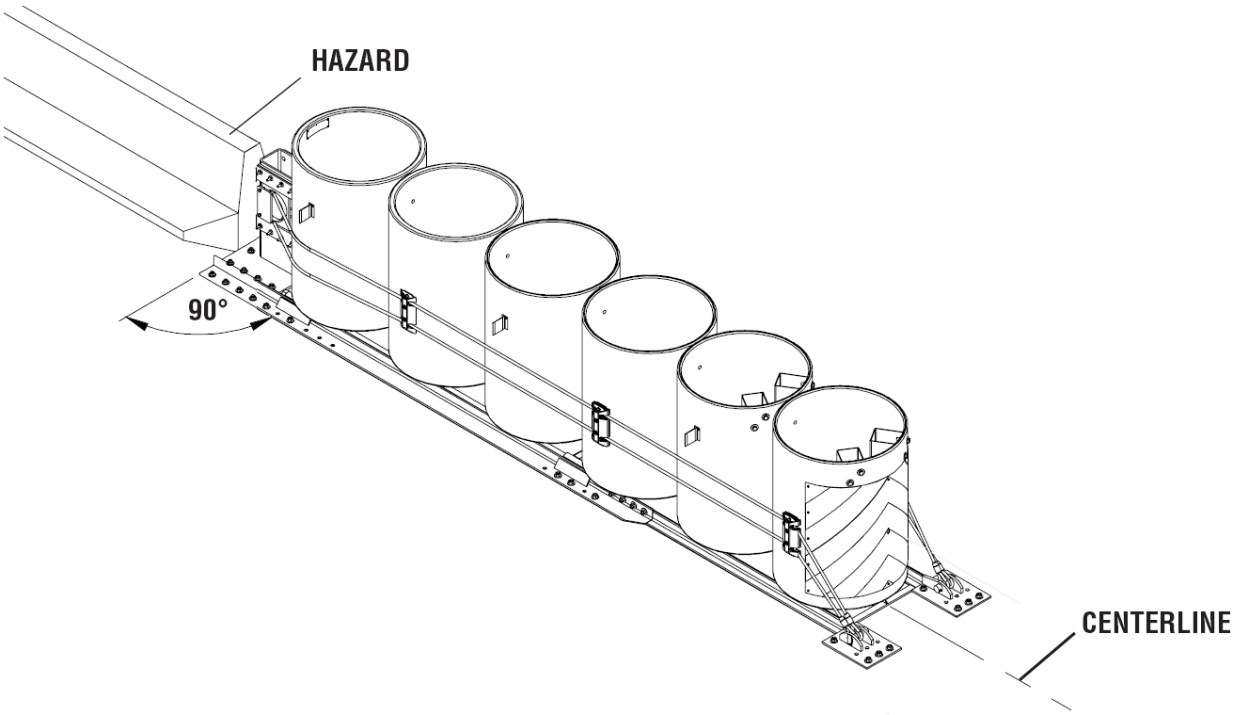


Figure 5
REACT 350® Narrow (36") Placement

3) Lifting/Placing the System

Mark the centerline on the front and rear of the base track. Use the lifting eyes (Figure 6) located on the middle rail of the rear base track (look down into the Cylinders) to lift the REACT 350® Narrow into place.

Use fixed-length slings with a 6,000 lb. [2,722 kg] minimum capacity. Fixed slings will prevent system tipping. Do not lift overhead. Measure the deployment from the centerline to ensure that the REACT 350® Narrow is centered and at the proper angle. The steel base track will rest flush against the roadside obstacle face for assemblies that do not require Transitions.

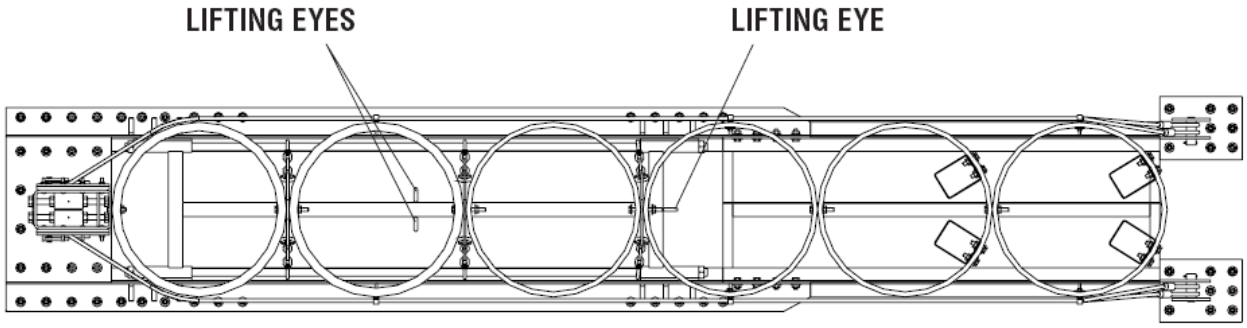


Figure 6
Lifting Eye Locations

For Self-Contained Backup Assemblies requiring Transition hardware to concrete wall or safety shape barrier, the Steel Base Track should be 5” [127 mm] forward of the roadside obstacle face (Figure 7).

Note: Concrete Backup (p. 17).

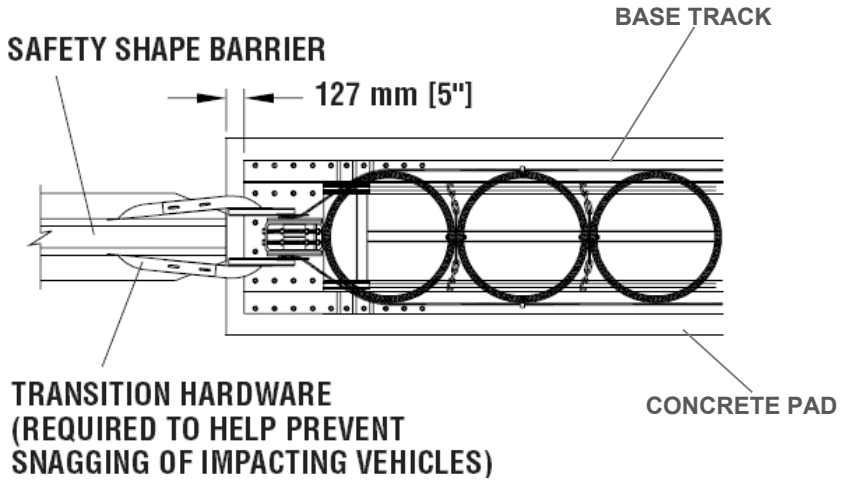


Figure 7
Base Track Location and Transition Hardware

4) Drill and Set Anchors

Use the holes in the Base Track as a template to locate and drill fifty-six (56) holes, 7/8” [22 mm] diameter x 6 1/4” [140 mm] deep into the concrete pad or roadway surface (Figure 8). **All holes in base plate must be used to anchor the REACT 350® Narrow to the foundation.** Use an approved adhesive kit to assemble 3/4” x 7 1/2” long studs using instructions included with kit. After adhesive has hardened, use 3/4" flat washers and nuts provided with the approved adhesive kit to anchor Base Track to foundation.

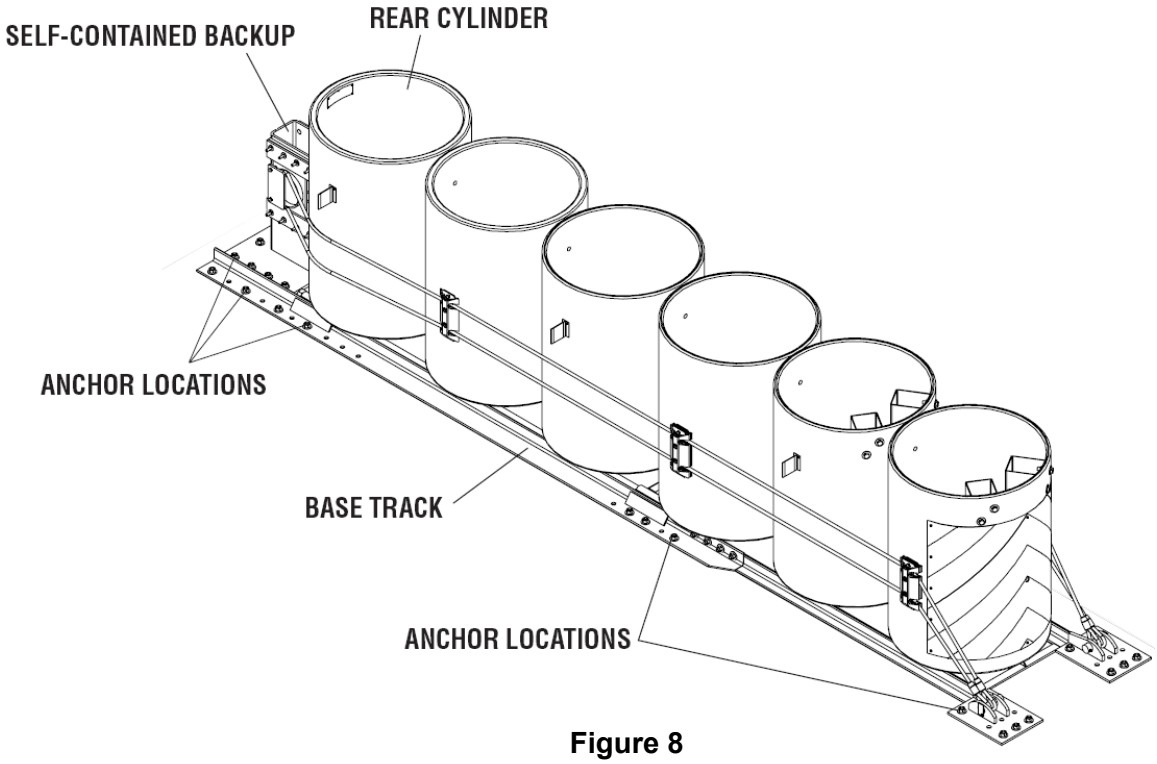


Figure 8
Anchoring the System

Important: Once the adhesive has hardened, torque nuts per adhesive manufacturer specifications. Refer to adhesive manufacturer kit instructions for hardening times.

5) Tension Restraining Cables

Use the two adjusting nuts at the rear of the Backup to tension the cables (Figure 9).

When properly tensioned, the cables should not deflect more than 3” [75 mm] with 100 lb. [45 kg] downward pressure.

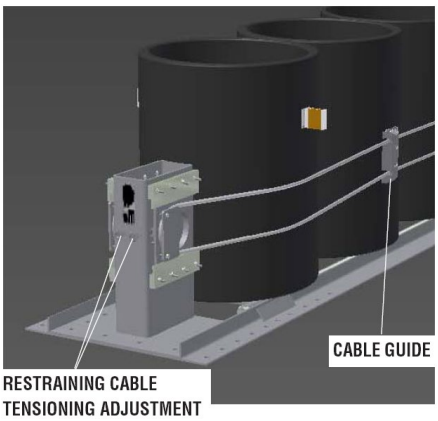


Figure 9
Restraining Cable Adjustment

Taper Toe Barrier

Transition panels must be added to any side exposed to traffic and the lower base or “toe” of the barrier must be tapered back at 15° maximum relative to traffic for a total width of 14” [356 mm]. This helps prevent interaction of wheels on impacting vehicles (Figure 10).

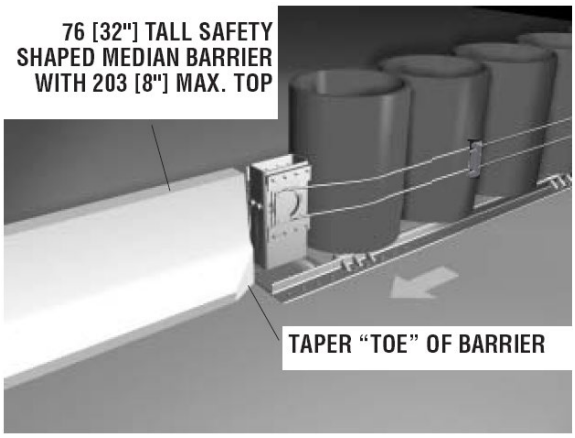


Figure 10
REACT 350® Narrow (36”) with Self-Contained Backup Shielding Safety Shape Barrier

Bidirectional Traffic

Self-Contained, Steel Backup

If a REACT 350® Narrow with Self-Contained Backup is placed in a location where traffic will be approaching from the rear, a transition from the object being shielded to the Backup may be required. See Offsetting the System on page 22 and Lifting/Placing the System on page 18. Hardware is available to mount w-beam guardrail or a safety shaped barrier to the Self-Contained Backup of the REACT 350® Narrow. A folded Transition Plate and w-beam connector can mount to either or both sides of the Backup Assembly (Figure 11). Special post spacing, rail, and rub rail will be required for guardrail.

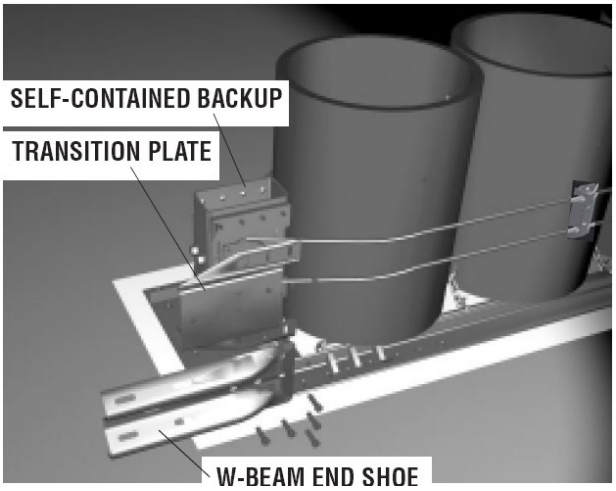


Figure 11
Transition Hardware

Concrete Backup

Note: The Drawing Package supplied with the REACT 350® Narrow must be used with these instructions for proper assembly and should take precedence over these general instructions.

1) Deploy Traffic Control

A traffic control plan appropriate to the complexity of the project should be prepared and understood by all parties before the REACT 350® Narrow is deployed.

Deploy the appropriate work zone safety devices prior to beginning the deployment and keep them present through all phases of the assembly.

2) Determining the Basepoint and Centerline

Typically the basepoint of the REACT 350® Narrow will be the midpoint of the roadside obstacle at its front face. This may change if bidirectional traffic or expansion joints are present (pp. 21 & 23).

Extend a chalk line from the basepoint, perpendicular to the roadside obstacle face, or as determined by project engineer to a distance greater than the maximum length of the REACT 350® Narrow (refer to the drawings provided). This chalk line will become the centerline for the REACT 350® Narrow (Figure 12).

When properly deployed, the REACT 350® Narrow will appear to be an extension of the object it is shielding.

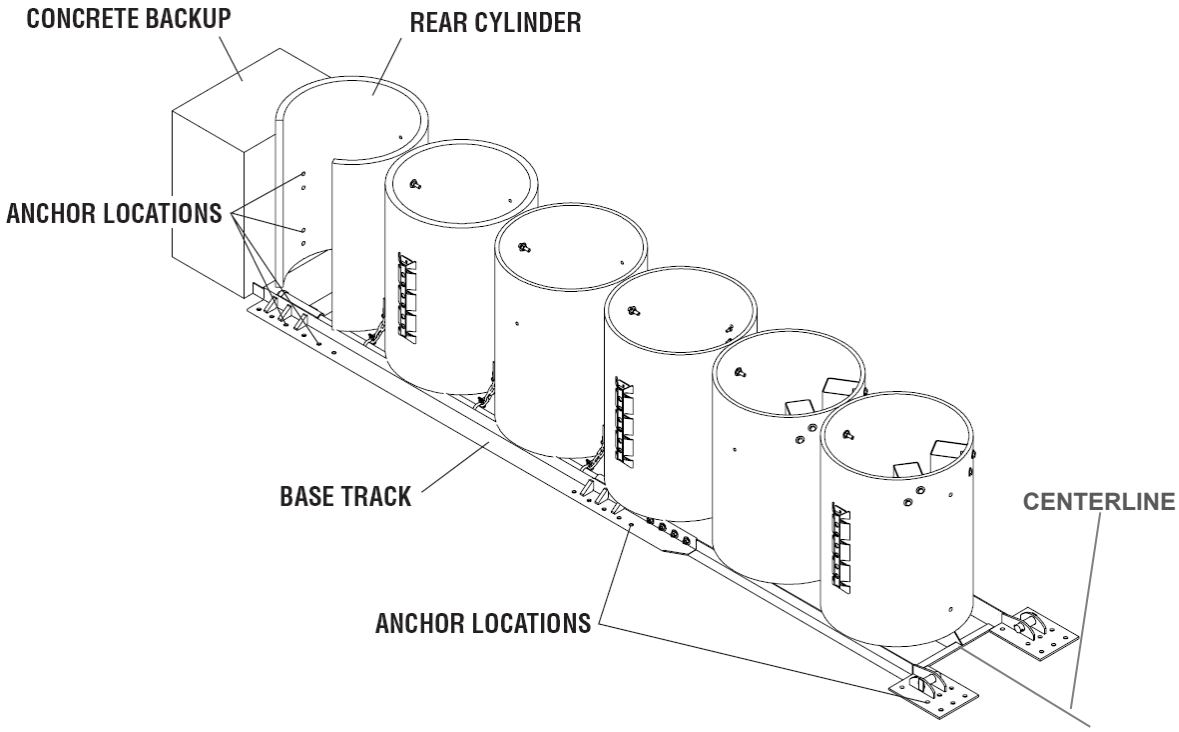


Figure 12
Anchoring the System

3) Lifting/Placing the System

Mark the centerline on the front and rear of the Base Track. Use the lifting eyes located on the middle rail of the rear Base Track (look down into the Cylinders) to lift the REACT 350® Narrow into place (p. 14).

Use fixed-length slings with a 6,000 lb. [2,722 kg] minimum capacity. Fixed slings will prevent system tipping. Do not lift overhead. Measure the deployment from the centerline to ensure that the REACT 350® Narrow is centered and at the proper angle. The steel Base Track will rest flush against the roadside obstacle face for assemblies that do not require Transitions.

4) Rear Cylinder Attachment

Use the holes in the Rear Cylinder as a template to locate and drill two holes, 22 mm [7/8”] diameter x 145 mm [5 3/4”] deep into the Concrete Backup (p. 17). Use an approved adhesive kit to assemble the 3/4” diameter x 8 1/2” long studs using instructions included with kit. After adhesive has hardened, use 3/4” nuts and flat washers included with approve adhesive kits to attach Cylinder assembly to Concrete Backup.

5) Drill and Set Anchors

Use the holes in the Base Track as a template to locate and drill thirty eight (38) holes, 22 mm [7/8”] diameter x 6 1/4” [160 mm] deep into the concrete pad or roadway surface (Figure 13). **All holes in Base Track must be used to anchor the REACT 350® Narrow to the foundation.** Use approved adhesive kits to assemble 3/4” diameter x 7 1/2” long studs using instructions included with kit. After adhesive has hardened, use 3/4" nuts and flat washers included with the approved adhesive kits to anchor Base Track to foundation.

Important: See page 8 for approved adhesive anchoring instructions.

6) Drill and Set Side Anchor Plate Anchors

For REACT 350® Narrow with a Concrete Backup, Side Cable Anchor Plates must be attached.

Warning: Vertical placement of the REACT 350® Narrow Side Anchor Plates is critical to performance. If an existing Backup is not high enough to fulfill these requirements, then special brackets are available from Customer Service (p. 3).

When properly deployed, the top of the Side Cable Anchor Plates should be 39” [991 mm] from the road surface. The front edge of the Side Cable Anchor Plates should be 3” [76 mm] from the front face of the Backup to avoid reinforcing steel. The tapered side of the Side Cable Anchor Plates should face the front of the system (p. 19). Use the holes in the Side Cable Anchor Plates as templates to match drill ten (10) holes per side of Backup, 7/8” [22 mm] diameter x 5 3/4" [145 mm] deep into the Concrete Backup. Use an approved adhesive to assemble the twenty (20) 3/4" diameter x 6 1/2" long studs using kit instructions. After adhesive has hardened, use 3/4" nuts and flat washers included with the approved adhesive kit to attach the Side Cable Anchor Plates to each side of the Concrete Backup (p. 19).

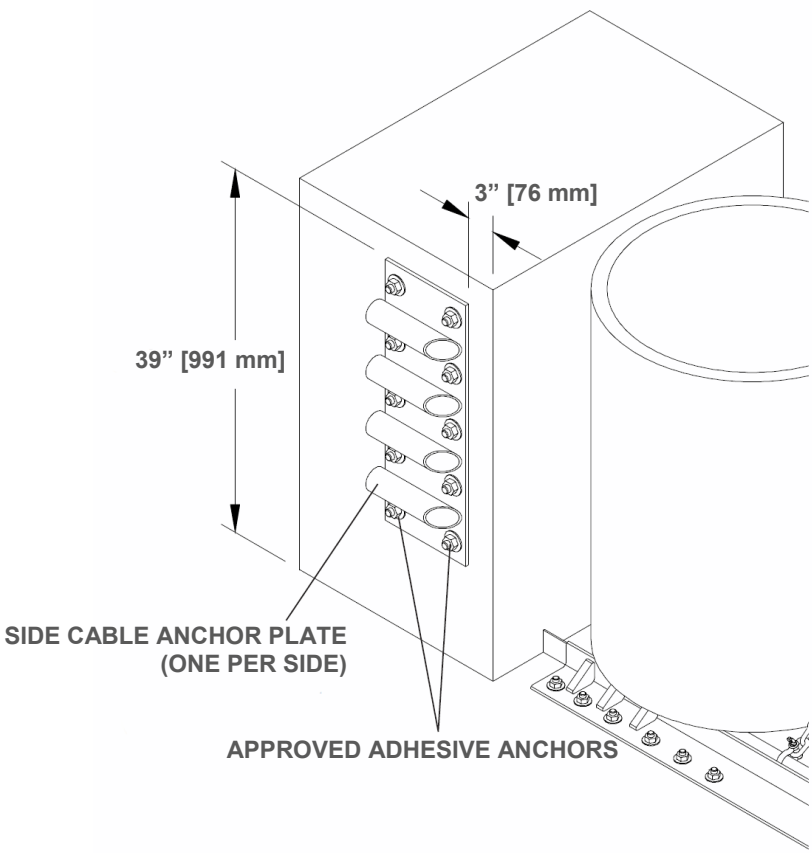


Figure 13
Side Cable Anchor Plates

Important: See page 8 for approved adhesive anchoring instructions.

7) Attach Restraining Cables

Four Restraining Cables must be attached: two on each side of Backup.

1. Slide the threaded end of a Restraining Cable through the third guide down and attach flat washer and nut (Figure 14). Tighten the nut so it is flush with the end of the threaded end of cable.
2. Route the Restraining Cable through the Cable Guides on the sides of the Cylinders, around the Restraining Cable pin as shown on page 21 (Figure 15), back through the Top Cable guides of the Cylinders, and through the Top Cable Guide of the Side Plate (Figure 14).
3. Pull on the cut end of the cable removing all possible slack. Slide the 3/4" flat washer and the ferrule over the end of the non-threaded end of the Restraining Cable. Mark the cable 2" back from the Anchor Plate. Leaving the ferrule and washer in place, cut the cable at the mark with a grinder or hack saw. Do not use a torch to cut the cable. Unbraid the end of the cable and insert the middle strand of the cable between the two halves of the wedge. Carefully wrap the remaining six (6) strands into the slots around the wedge then push into ferrule to tighten (Figure 14 and Detail A). Use a drift pin and sledge hammer to seat the ferrule into the cable receptacles.

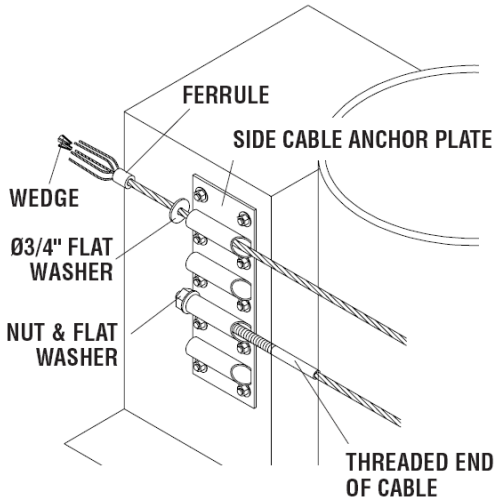


Figure 14
Routing First Cable

Detail A
Cable Ferrule

Repeat these steps for remaining three Restraining Cables ensuring that the threaded ends of the Restraining Cables are attached through the lower two Guides as shown on page 21.

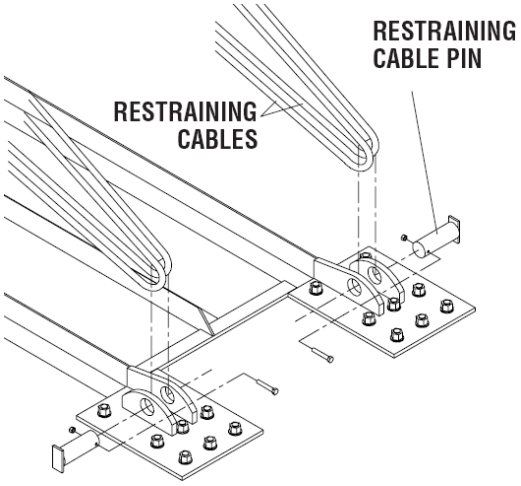


Figure 15
Front of System Cable Attachment
(Concrete Backup)

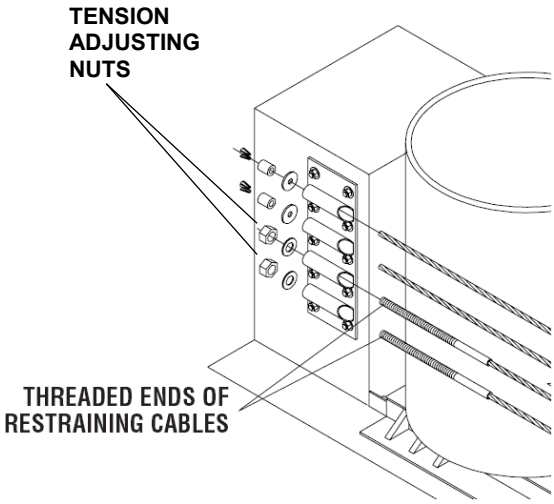


Figure 16
Rear of System Cable Attachment
(Concrete Backups)

8) Tension Restraining Cables

Use the nuts on the threaded end of the Cables to tension the cables (Figure 16).

When properly tensioned, the Cables should not deflect more than 3" [75 mm] with 100 lb. [45 kg] downward pressure.

Bidirectional Traffic

Concrete Backup

If a REACT 350® Narrow with Concrete Backup is placed in a location where traffic will be approaching from the rear, the Backup should not protrude beyond the roadside feature being shielded. Concrete tapering may be required. Also, an additional standard Side Anchor Plate should be rotated 180 degrees and placed behind the first Anchor Plate (Figures 18). In this case, the Backup must be 30" [762 mm] long. Refer to Figure 19 on page 22 for placement and Step 6 on page 18 for anchoring information.

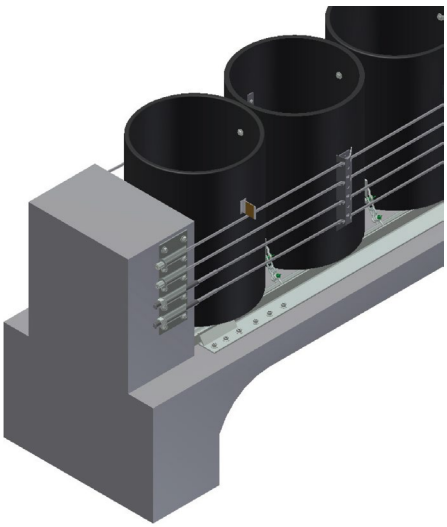


Figure 17
Restraining Cable Adjustment
(Concrete Backup)

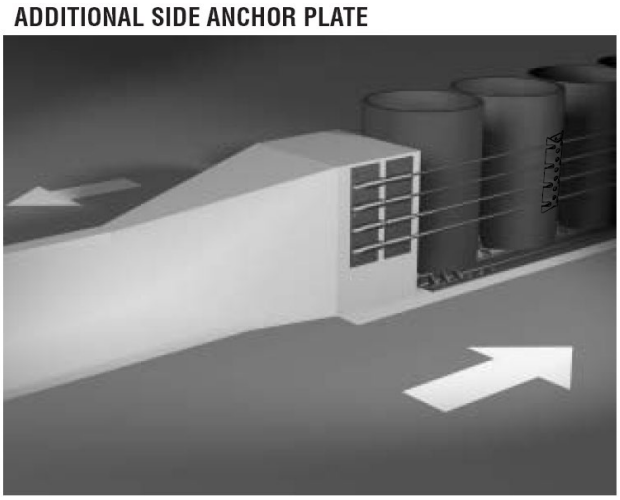


Figure 18
Transitioning to the REACT 350®
Narrow (36") with Concrete Backup

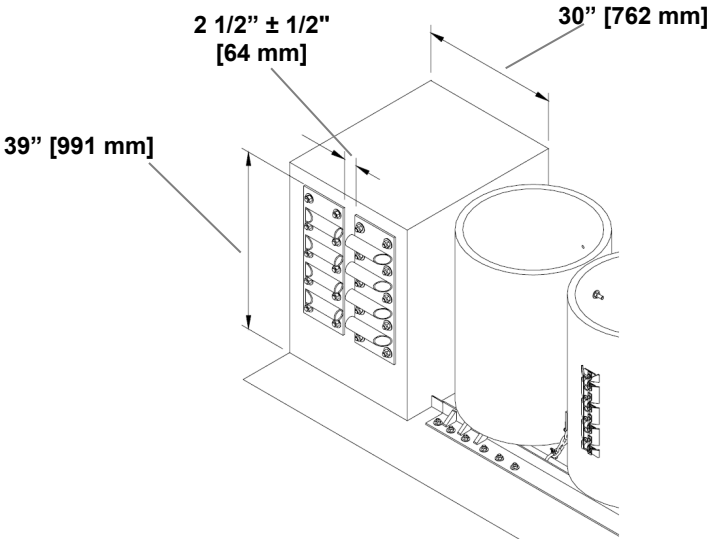


Figure 19
Assemble additional Anchor Plate for Bidirectional Traffic

Roadside Obstacle Width

The REACT 350® Narrow with a Concrete Backup may shield obstacles up to 36” [914 mm] wide. The Backup must be 30” [762 mm] to 36” [914 mm] wide to use standard Side Anchor hardware.

Offsetting the System

The REACT 350® Narrow with Self-Contained Backup may shield roadside features up to 24” [610 mm].

If space permits, REACT 350® Narrow may be offset from the center of the roadside obstacle. Offsetting may be necessary for two reasons:

1) To shield an obstacle wider than 8” [200 mm]
2) If bidirectional traffic is present

When offsetting the REACT 350® Narrow, align the edge of the Cylinders with the side of the barrier (Figure 20). With this method, REACT 350® Narrow with Self-Contained Backup may shield roadside obstacles up to 24” [610 mm]. If a wider obstacle is present, a Concrete Backup may be required. Contact Valtir Customer Service Department if you have questions concerning Concrete Backup requirements (p. 3).

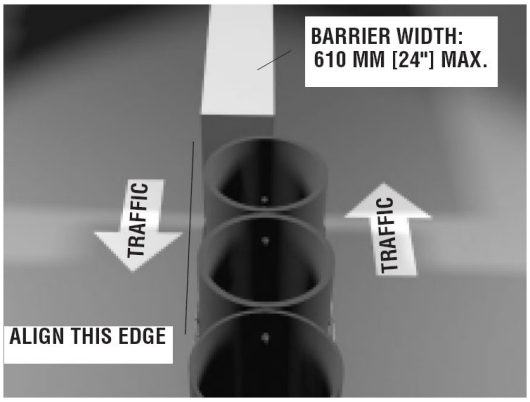


Figure 20
Offsetting the REACT 350® Narrow

Longitudinal Joint Application

The REACT 350® Narrow with Concrete Backup and split Base Track may span longitudinal expansion or construction joints.

Warning: **Transverse joint applications are prohibited** and longitudinal joint movement must be limited to 1.5” [38 mm].

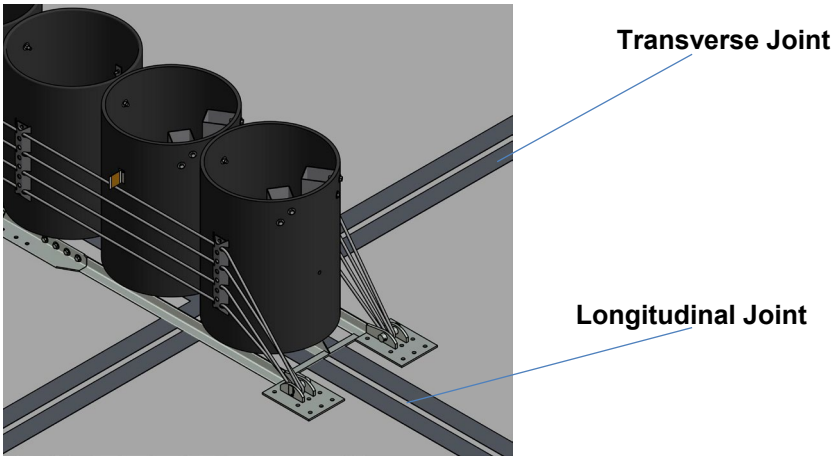


Figure 21
Longitudinal and Transverse Joints Shown

Attach Nose Cover

1. Ensure the nose cover suits site conditions (Figure 21).
2. Refer to local standards and MUTCD for nose delineation.

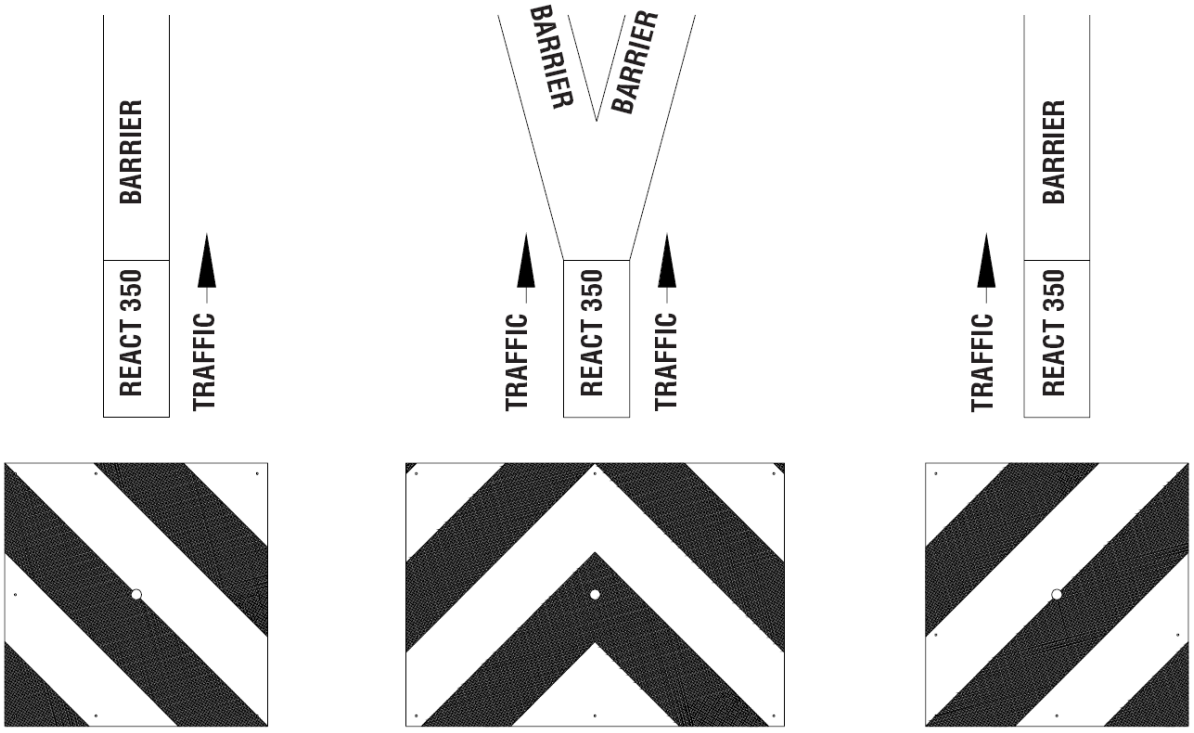


Figure 22
Nose Cover Selection

3. Align 1” diameter hole in nose cover with 1” diameter hole in Cylinder.
4. Screw 1/4” self-tapping screw into Cylinder punching through reflective tape and the existing holes in nose cover until head of fastener is flush for all 12 places (p. 24, Figure 22).

Attach Side Mount Reflectors

Refer to local standards and MUTCD for Reflectors.

For Side Mount Reflectors, attach to traffic side(s) of the system with the white side facing traffic by screwing 1/4" self-tapping screws through the Reflector and into the Cylinder until head of fastener is flush for two places per Reflector (p. 25, Figure 23).

Warning: It is the responsibility of the installer to ensure that your assembly meets all appropriate Manual on Uniform Traffic Control Devices (“MUTCD”) and local standards.

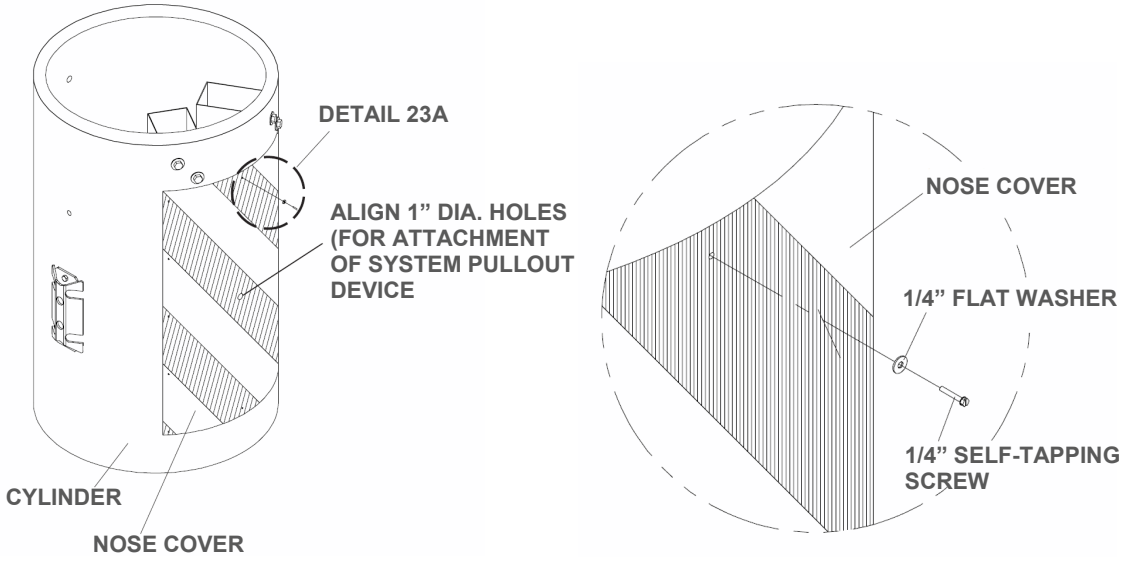


Figure 23
Nose Cover Assembly

DETAIL 23A

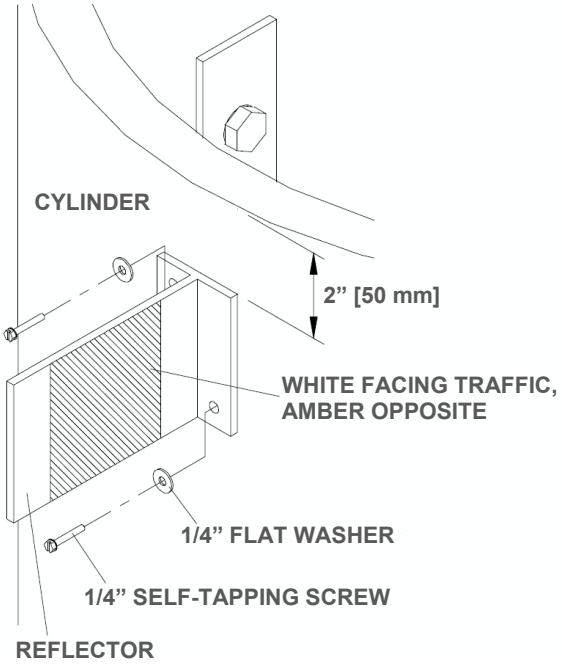


Figure 24
Side Mounted Reflector

Warning: It is the responsibility of the installer to ensure the REACT 350® Narrow deployment and delineation meet all federal, state, specifying agency, and local specifications.

Optional Debris Covers

To attach Optional Debris Covers, center a cover on Cylinder 1. Note the orientation of the grommets. The two grommets closest together should be located in the front or rear of the Cylinder (Figure 25).

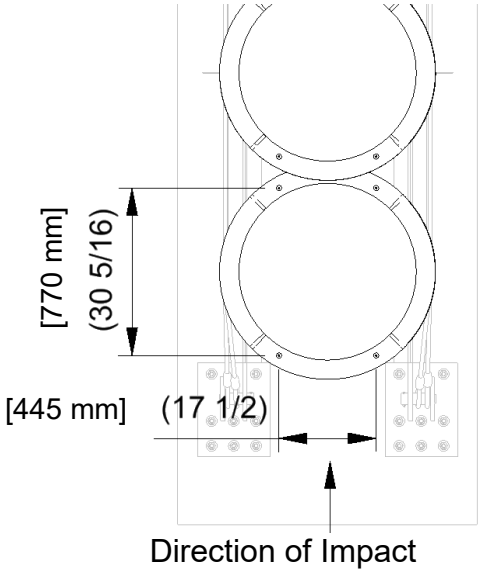


Figure 25

Next attach the cover to the Cylinder with four (4) #10 flat head self-tapping screws and fender washers, ensuring all screws are positioned in the middle of the Cylinder wall (Figure 26).

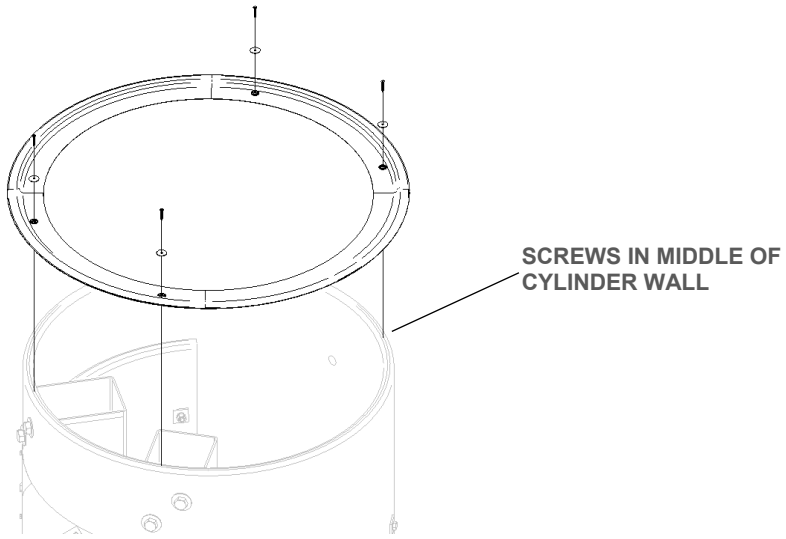


Figure 26

Continue to attach the remaining covers as described above.

Note: The covers may overlap and the overlap direction is not critical to system performance.

Maintenance and Repair

The REACT 350® Narrow, within NCHRP Report 350 criteria crash testing, has been shown to be a potentially reusable crash cushion. However, whether or not a system is reusable is the sole discretion of the highway authority specifying their use.

Warning: Use only Valtir parts specified herein for assembly, maintenance, or repair of the REACT 350® Narrow. **The assembly or comingling of unauthorized parts is strictly PROHIBITED.** The REACT 350® Narrow and its component parts have been accepted for state use by the FHWA. However, a comingled system has not been accepted within the applicable criteria.

Warning: After an impact, always follow the “Post-Impact Instructions” (p. 31).

The REACT 350® Narrow must be inspected after each impact. Depending on the impact, components may get damaged and need replacement. A cylinder requires replacement when the minor axis of the cylinder stays permanently at 18” [460 mm] or less (Figure 26) or the system does not reach 90% of the original length. It is critical that all cables and anchoring be checked and returned to original assembly conditions. Any parts used in the repair of the system must be original Valtir parts (p. 3).

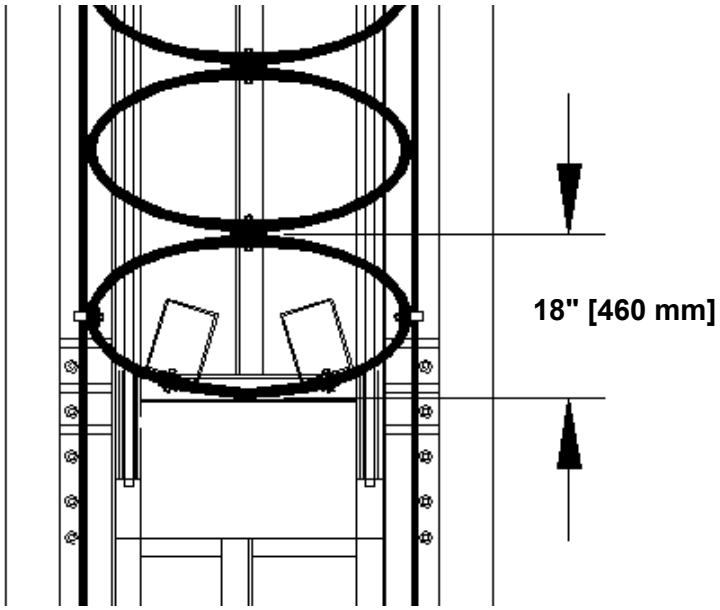


Figure 27 – Measure Minor Axis

REACT 350® Narrow Final Inspection Checklist

Site Location: _____

Date: _____

Inspector: _____

- ☐ Appropriate transitions are in place and properly fitted (p. 16)
- ☐ Every hole on the Base Track is fastened by an anchor (p. 15, 17)
- ☐ Each anchor is torqued to adhesive manufacturer specification (p. 8)
- ☐ All cables are attached and tensioned (p.15, 21)
- ☐ Ensure pre-assembled hardware fasteners have not loosened during shipment
- ☐ Each Cylinder is properly positioned on Base Track
- ☐ Clear all construction debris in and around system

Maintenance and Repair

Inspections by the appropriate highway authority are recommended as determined by that authority based upon volume of traffic and impact history. Visual drive-by inspections are recommended at least once every three months. Walk-up inspections are recommended at least twice a year.

Warning: After an impact, always follow the “Post-Impact Instructions” (p. 31).

Visual Drive-By Inspection

1. Check to see if there is evidence of an impact. Check to verify that the REACT 350® Narrow is fully extended from the backup. If it is not, a walk-up inspection will be necessary to determine the cause.
2. Note the location and condition of the REACT 350® Narrow and the date of visual drive-by inspection on a log sheet.

Warning: Debris, snow, or ice inside the cylinders may prevent the REACT 350® Narrow from absorbing the impact of a crash as observed in NCHRP Report 350 compliant crash testing. Perform a walk-up inspection as needed to check for and dispose of any debris inside the Cylinders. Failing to remove this debris or other material infringes upon the performance of the system observed in FHWA accepted crash testing.

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.

Walk-Up Inspection Checklist

Date: _____

Inspector: _____

- ☐ Remove any debris under or around the REACT 350® Narrow.
- ☐ Remove any debris found inside the Cylinders.
- ☐ Check for evidence of bent or damaged parts to replace them as soon as possible.
- ☐ Verify that all nuts and bolts are tight and rust free.
- ☐ Ensure each Concrete Anchor Bolt is securely anchored using an approved adhesive.
- ☐ Verify that all Cylinders are in good condition and centered on the Base Track. Any Cylinder that is cracked or otherwise damaged should be replaced. Measure the minor axis of the Cylinders.
- ☐ Replace Cylinders when the minor axis of the cylinders measures 18” [460 mm] or less (p. 27).
- ☐ Ensure all cables are attached and tensioned with parts specified for use in this system.
- ☐ Note the location and condition of the REACT 350® Narrow and any work done for the date of this inspection. If further repair is necessary, note the repair requested. Refer to the standard drawing and assembly section of this manual for more information.

Warning: The correct safety equipment and approved traffic management must be used as required for walk-up inspections of the REACT 350® Narrow.

Post-Impact Instructions

1. Deploy the appropriate **traffic control** devices to protect repair crew.

Warning: The correct safety equipment and approved traffic management must be used as required for walk-up inspections of the REACT 350® Narrow.

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.

2. Check to see that all anchor bolts have remained firmly anchored in the roadway surface and in the Concrete Backup, if applicable. Replace any anchors that are loose, broken, or pulled out.

   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.
3. Clear and dispose of any debris around or inside the Cylinders and on site.
4. Check the condition of the Cylinders. Any Cylinder that is cracked or otherwise damaged should be replaced. Measure the minor axis of the Cylinders. Cylinders require replacement if the minor axis measures 18” [460 mm] or less (p. 27).
5. The REACT 350® Narrow must be pulled out to its original length after each impact. The Pullout Assembly must be attached prior to this procedure and removed and stored when finished (Figure 27).

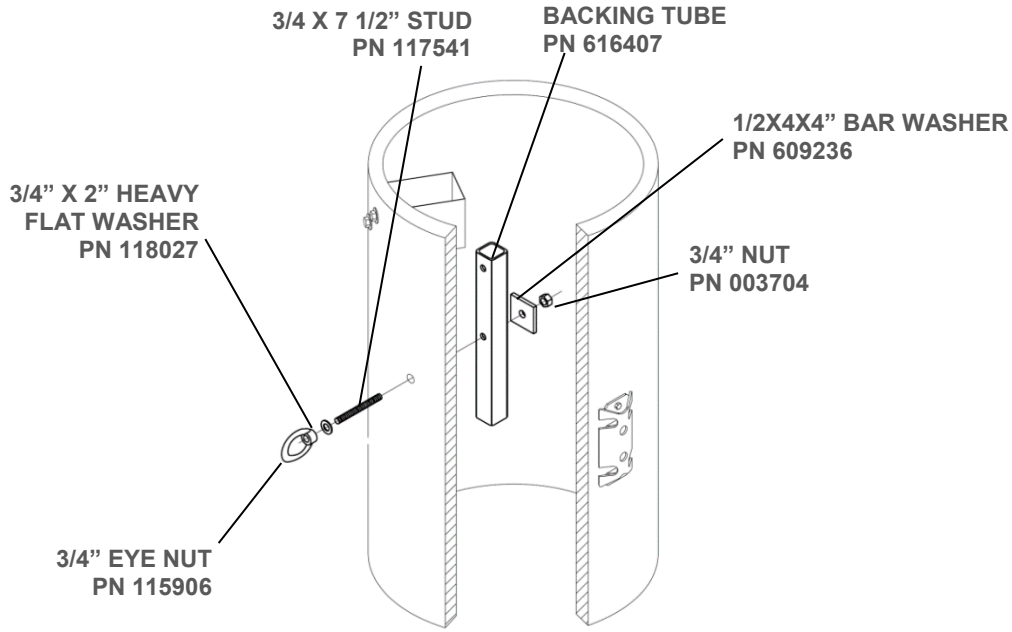


Figure 27 - Pullout Assembly

Site Data Form

(Please make copies)

Created by_____ Date Submitted_____

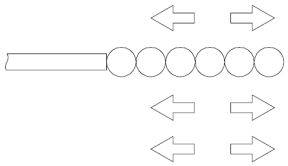
Company_____ Date Required_____

Site Location / Title _____

City/County_____ State/Country_____

1. Location of hazard:
___ Median ___Gore ___Roadside ___Toll

2. Direction of traffic (circle all appropriate arrows)



3. Object being protected: (sketch hazard and dimension)

___Concrete Barrier (show barrier with dimensions)
___New Jersey Barrier, ___F Shape Barrier,
___Single Slope Barrier, ___Other
___Guardrail (show cross section with dimensions)
___Thrie-Beam, ___W-Beam, ___Other

4. Design Speed of Roadway _____ (mph or km/h) Sketch of hazard

5. Foundation ____Grade, ____Deck structure, ____Continuous concrete pavement

6. Does expansion joint pass through System location? ___ No, ___Yes. If yes, attach a drawing of site showing the exact location of the joint. What is the maximum movement in the joint? _____ Show the direction of movement.

7. Does curbing exist? _____ No, _____Yes If yes, what is the curb height?

8. Is cross slope greater than 8%? _____No, ____Yes If yes, what is the slope?

9. Provide photos and/or sketches of the site. Be sure to give dimensions for obstacles.
(Use the back of this sheet or attach an additional sheet with sketches of the site.)

10. Number of impacts expected per year?

11. Drawings requested
_____ Quantity _____ Drawing Size (11x17 unless specified)

_____ Set _____Cover Sheet Only _____ Cover sheet and Concrete Work

12. Temporary/Construction Zone or Permanent

Order Form

(Please make copies)

Bill To: _____

_____

_____

Ship To: _____

_____

_____

Date: _____ Order No. _____

Job No. _____

Job Name: _____

Project No. _____

Section No. _____

IMPORTANT: Use one sheet per System unless the Systems are identical.

Special instructions _____

_____

Transitions

_____

_____

_____

Reflective Nose Cover (Specify one)

____ Right ____ Gore ____ Left ____ Special



Notes:

VALTIR
A TIER ABOVE

For more complete information on Valtir products and services, visit us on the web at www.valtir.com. Materials and specifications are subject to change without notice. Please contact Valtir to confirm that you are referring to the most current instructions.

WWW.VALTIR.COM

1.888.323.6374