

# **REACT 350<sup>®</sup>**

## **Narrow (36")**

### **Assembly Manual**



**TRINITY**  
**HIGHWAY**

*Ahead of the Curve<sup>™</sup>*

# REACT 350<sup>®</sup> Narrow (36")

## Assembly Manual



2525 Stemmons Freeway  
Dallas, Texas 75207



**Important:** These instructions are to be used only in conjunction with the assembly, maintenance, and repair of the REACT 350<sup>®</sup> Narrow system. These instructions are for standard assemblies specified by the appropriate highway authority only. 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 system has been accepted by the Federal Highway Administration for use on the national highway system under strict criteria utilized by that agency. Trinity Highway representatives are available for consultation if required.

**This Manual must be available to the worker overseeing and/or assembling the product at all times. For additional copies, contact Trinity Highway at (888) 323-6374 or download copies from the website below.**

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<sup>®</sup> Narrow system information available to Trinity Highway at the time of printing. We reserve the right to make changes at any time. Please contact Trinity Highway to confirm that you are referring to the most current instructions.

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## Customer Service Contacts

Trinity Highway is committed to the highest level of customer service. Feedback regarding the REACT 350<sup>®</sup> Narrow system, its assembly procedures, supporting documentation, and performance is always welcome. Additional information can be obtained from the contact information below:

### **Energy Absorption Systems, Inc. dba Trinity Highway**

Telephone:	(888) 323-6374 (USA) (214) 589-8140 (International)
E-mail:	product.info@trin.net
Website:	www.trinityhighway.com

## Important Introductory Notes

Proper assembly of REACT 350<sup>®</sup> Narrow system is critical to achieve performance that has been evaluated and accepted by the Federal Highway Administration (FHWA) per NCHRP Report 350. These instructions should be read in their entirety and understood before assembling the REACT 350<sup>®</sup> Narrow system. These instructions are to be used only in conjunction with the assembly of the REACT 350<sup>®</sup> Narrow system 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<sup>®</sup> Narrow system, please contact the highway authority that has planned and specified this assembly and, if needed, contact Trinity Highway'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 it was tested and accepted.

This system, like other Trinity Highway systems, has been crash tested pursuant to NCHRP Report 350 mandated criteria



**Important: DO NOT** use any component part that has not been specifically crash tested and/or 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 drawing package will be supplied by Trinity Highway 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.



**Important:** Read safety instructions thoroughly and follow the assembly directions and suggested safe practices before assembling, maintaining, or repairing the REACT 350<sup>®</sup> Narrow system. Failure to follow this warning can result in serious injury or death to workers and/or bystanders. Such failure also compromises the acceptance of this system by the FHWA. 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 REACT 350<sup>®</sup> Narrow system Danger, Warning, Caution, and Important statements within the REACT 350<sup>®</sup> Narrow system Manual are completely followed. Failure to follow this warning could result in 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 REACT 350<sup>®</sup> Narrow system. Additional copies of this Manual are immediately available from Trinity Highway by calling (888) 323-6374 or by email at [product.info@trin.net](mailto:product.info@trin.net). Please contact Trinity Highway if you have any questions concerning the information in this Manual or about the REACT 350<sup>®</sup> Narrow system. This Manual may also be downloaded directly from the website below.

Always use appropriate safety precautions when operating power equipment, mixing chemicals, and when moving heavy equipment or REACT 350<sup>®</sup> Narrow system components. Work gloves, apron, safety goggles, safety-toe shoes, and back protection should be used.

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

## Safety Symbols

This section describes the safety symbols that appear in this REACT 350<sup>®</sup> 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.

## Warnings and Cautions

Read all instructions before assembling, maintaining, or repairing the REACT 350<sup>®</sup> Narrow 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 has not been accepted by the Federal Highway Administration (FHWA).



**Warning:** Do not assemble, maintain, or repair the REACT 350<sup>®</sup> Narrow 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 Trinity Highway at (888) 323-6374 if you do not understand these 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.



**Warning:** Use only Trinity Highway parts that are specified herein for the REACT 350<sup>®</sup> for assembling, maintaining, or repairing the REACT 350<sup>®</sup> Narrow system. **Do not utilize or otherwise comingle parts from other systems even if those systems are other Trinity Highway 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.



**Warning:** Do NOT modify the REACT 350<sup>®</sup> Narrow system in any way.



**Warning:** Ensure that the REACT 350<sup>®</sup> Narrow system and delineation used meet all federal, state, specifying agency, and local specifications.



**Warning:** Ensure that your assembly meets all appropriate Manual on Uniform Traffic Control Devices (MUTCD) and local standards.



**Warning:** Ensure that there is proper site grading for the REACT 350<sup>®</sup> Narrow system placement as dictated by the state or specifying agency, pursuant to Federal Highway Administration (FHWA) acceptance.



**Warning:** Use only Trinity Highway parts on the REACT 350<sup>®</sup> Narrow system for assembly, maintenance, or repair. **The assembly or comingling of unauthorized parts is strictly PROHIBITED.** The REACT 350<sup>®</sup> 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.



**Important:** Trinity Highway 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.



**Warning:** Ensure that this assembly conforms with the guidance provided by the AASHTO Roadside Design Guide, including, but not limited to, those regarding placement on or adjacent to curbs.

## **Limitations and Warnings**

Trinity Highway, in compliance with the National Cooperative Research Highway Program 350 (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 Federal Highway Administration for review.

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

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

Test Level 3: 100 km/h [62 mph]

**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.**

Trinity Highway neither represents nor warrants that the impact results of these federally established test criteria prevent or reduce the severity of any injury to person(s) or damage to property. 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<sup>®</sup> Narrow system 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.

## **System Overview**

The REACT 350<sup>®</sup> Narrow is a potentially reusable, redirective, non-gating crash cushion for roadside obstacles ranging in width from 203 mm to 914 mm (8" to 36").

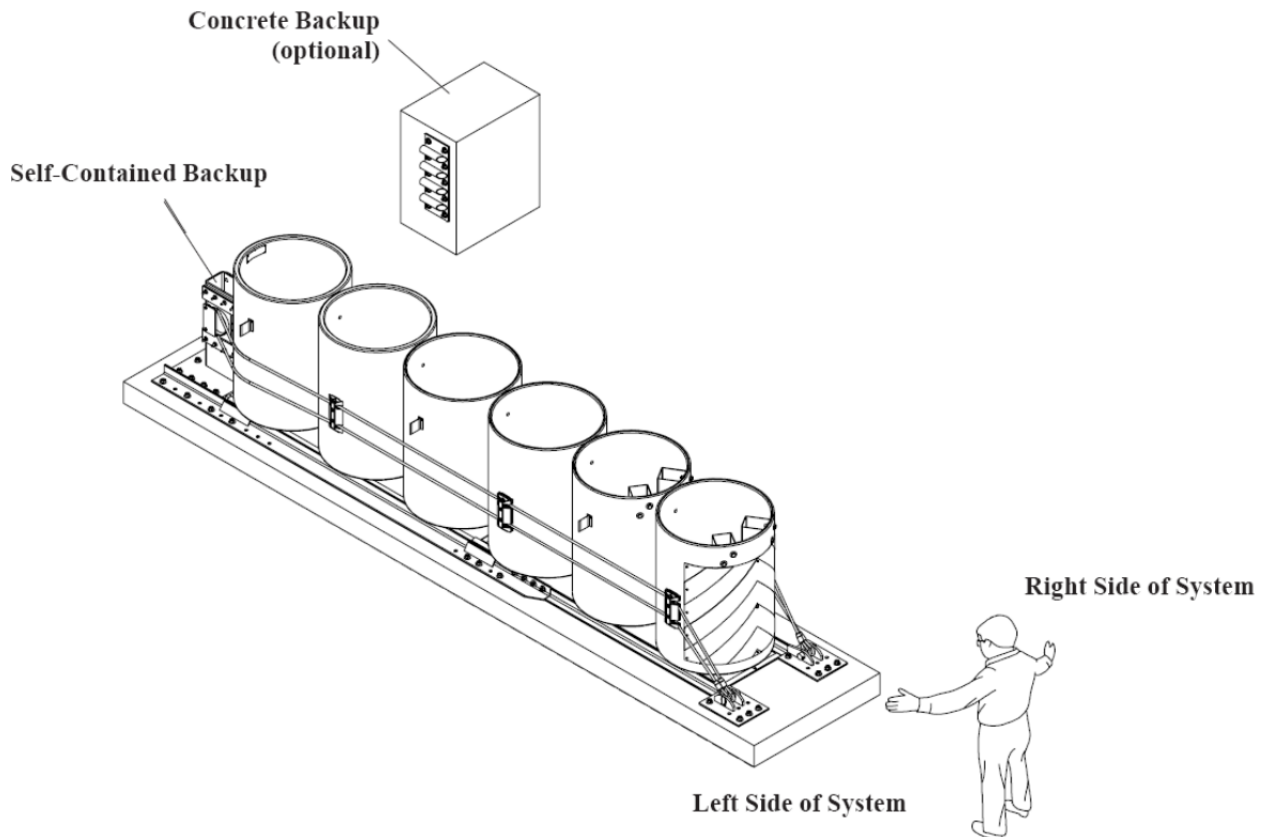
The REACT 350<sup>®</sup> Narrow system utilizes three types of Cylinders in a "staged" configuration to address both lighter cars and heavier, high center-of-gravity vehicles. Its modular design allows the system length to be tailored to the design speed of a site. Refer to the REACT 350<sup>®</sup> Narrow 36" Product Manual to determine the appropriate length system for a given speed.

## **Impact Performance**

The 4 Cylinder REACT 350<sup>®</sup> 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 70 km/h [43 mph] at angles up to 20 degrees.

The 9 Cylinder REACT 350<sup>®</sup> 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 100 km/h [62 mph] at angles up to 20 degrees.

During head-on impacts, within the above-referenced criteria, the REACT 350<sup>®</sup> 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<sup>®</sup> Narrow (36") with Self-Contained Backup**



# **Assembly**

## **Recommended Tools**

### **Documentation**

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

### **Cutting equipment**

- Rebar cutting bit
- Rotary hammer drill
- Concrete drill bits – 22 mm [7/8"] x 178 mm [7"] (\*Double-Fluted)
- Grinder, Hacksaw or Torch (optional)

\* Trinity Highway recommends using double-fluted drill bits to achieve optimum tensile strength when applying the MP-3<sup>®</sup> anchoring system.

### **Hammers**

- Sledgehammer

### **Wrenches**

- Heavy duty impact wrench
- Standard adjustable wrench
- 1/4", 5/16", 3/8", 3/4" 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" combination wrenches
- Large Pipe Wrench

### **Screwdrivers**

- Screw gun or Standard Drill with adapter chuck for small screws/bolts
- Flat Screwdriver
- Phillips Screwdriver

### **Personal Protective equipment**

- Safety Glasses
- Gloves
- Safety-Toe Shoes
- Apron for MP-3<sup>®</sup> application

## Miscellaneous

- Traffic control equipment
- Lifting and moving equipment (A lifting device is preferred although a forklift can be used.) Minimum 2722 kg [6,000 lb.] capacity required. For the 4 Cylinder REACT 350® Narrow (36") on the precast pad, 4536 kg [10,000 lb.] capacity required. Do not lift overhead.
- Compressor (100 psi) and Generator (5 kW)
- Long pry bar
- Drift pin
- Tape measure 7.5 m [25']
- Chalk line
- Nylon bottle brush for cleaning drilled holes
- Rags, water, and solvent for touch-up

**Note:** The above list of tools is a general recommendation. Depending on specific site conditions and the complexity of the assembly specified by the appropriate highway authority, additional or fewer tools may be required. Decisions as to what tools are needed to perform the job are entirely within the discretion of the specifying highway authority and the authority's selected contractor performing the assembly of the system at the authority's specified site.

**Note:** Refer to Assembly Procedures for a complete list of instructions.

## **Site Preparation/Foundation**

A REACT 350<sup>®</sup> Narrow should be assembled on an existing or freshly placed and cured concrete base (28 MPa [4000 psi] minimum). Use 178 mm [7"] Threaded Rods attached with the two-part MP-3<sup>®</sup> grout. Location and orientation of the concrete base and attenuator must comply with project plans or as otherwise determined by the resident project engineer.

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

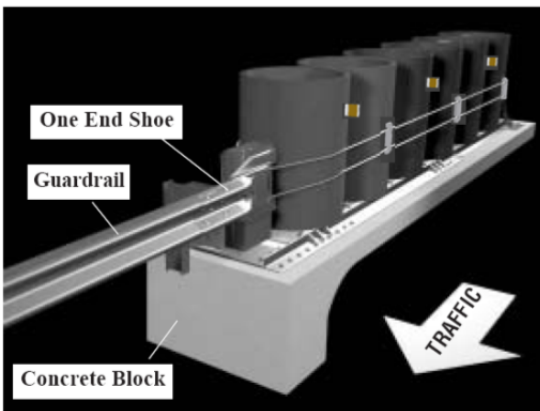
Recommended dimension and reinforcement specifications for new concrete foundations are provided in Trinity Highway concrete foundation drawings, supplied with the system. The system may be assembled on a non-reinforced concrete roadway (minimum 200 mm [8"] thick).



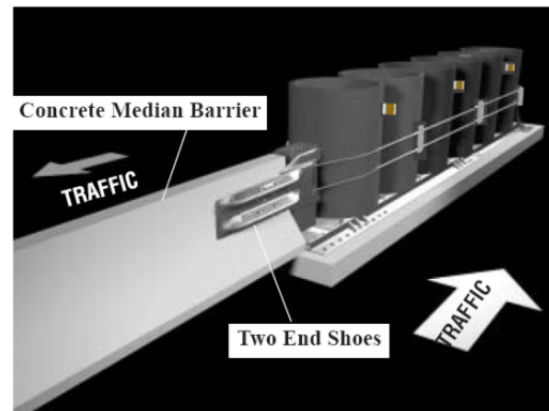
**Caution:** Accurate placement of all steel rebar is critical to avoid interference with the concrete anchor bolts.

### **Inspect Shipping**

Before deploying the REACT 350<sup>®</sup> Narrow, check the received parts against the shipping list supplied with the system. Make sure all parts have been received.



**Figure 2**  
**Permanent Construction which**  
**requires Below-Grade Anchor Block**



**Figure 3**  
**Permanent Construction which does not**  
**require Below-Grade Anchor Block**

# **Foundation Specifications**

## **Concrete Anchoring**

For concrete anchoring, the REACT 350<sup>®</sup> Narrow should be mounted 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.

## **Asphalt Anchoring**

Assemblies on asphalt must provide a minimum of 76 mm [3"] layer of asphalt over a minimum of 76 mm [3"] layer of Portland Cement concrete, 152 mm [6"] layer of asphalt over 152 mm [6"] layer of subbase, or 203 mm [8"] layer of asphalt with no subbase. 460 mm [18"] Threaded Rods, installed with the two-part MP-3<sup>®</sup> grout, must be used for these foundations.



**Important:** Systems mounted on asphalt must be replaced and mounted on fresh, undisturbed asphalt if more than 10% of anchors are found to be loose, broken, or show signs of pull out. If 10% or fewer anchors are damaged, replace the damaged anchors in the existing asphalt. Anchor bolts used on systems mounted on asphalt must be inspected every 6 months. See Post Impact Instructions and Maintenance and Repair instructions on page 34.

The REACT 350<sup>®</sup> Narrow may be placed on any of the following foundations using the specified anchorage:

### **Foundation A: Concrete Pad or Roadway**

Foundation: 150 mm [6"] minimum depth Portland Cement Concrete (P.C.C.)

Anchorage: MP-3<sup>®</sup> with 180 mm [7"] studs 140 mm [5 1/2"] embedment

### **Foundation B: Asphalt over P.C.C.**

Foundation: 76 mm [3"] minimum asphalt concrete (A.C.) over 76 mm [3"] minimum P.C.C.

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

### **Foundation C: Asphalt over Subbase**

Foundation: 150 mm [6"] minimum A.C. over 150 mm [6"] minimum Compacted Subbase (C.S.)

Anchorage: MP-3<sup>®</sup> with 460 mm [18"] studs 420 mm [16 1/2"] embedment

### **Foundation D: Asphalt Only**

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

Anchorage: MP-3<sup>®</sup> with 460 mm [18"] studs - 420 mm [16 1/2"] embedment

## **Foundation Specifications**

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

**A. C. (Asphalt Concrete)**

AR-4000 A. C. (per ASTM D3381 '09) 3/4" Maximum, Medium (Type A or B) aggregate

Sieve Size	Operating Range (%) Passing
1"	100
3/4"	95-100
3/8"	65-80
No. 4	49-54
No. 8	36-40
No. 30	18-21
No. 200	3-8



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

**P.C.C. (Portland Cement Concrete)**

Stone aggregate concrete mix

4000 psi minimum compressive strength

(Sampling per ASTM C31 or ASTM C42, testing per ASTM C39)

**C.S. (Compacted Subbase)**

150 mm [6"] minimum depth 95% compaction

Class 2 aggregate

Sieve Size	Moving Average (%) Passing
3"	100
2 1/2"	90-100
No. 4	40-90
No. 200	0-25

## **Self-Contained Backup Assembly**

**Note:** The Drawing Package supplied with the REACT 350<sup>®</sup> 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<sup>®</sup> Narrow is deployed.

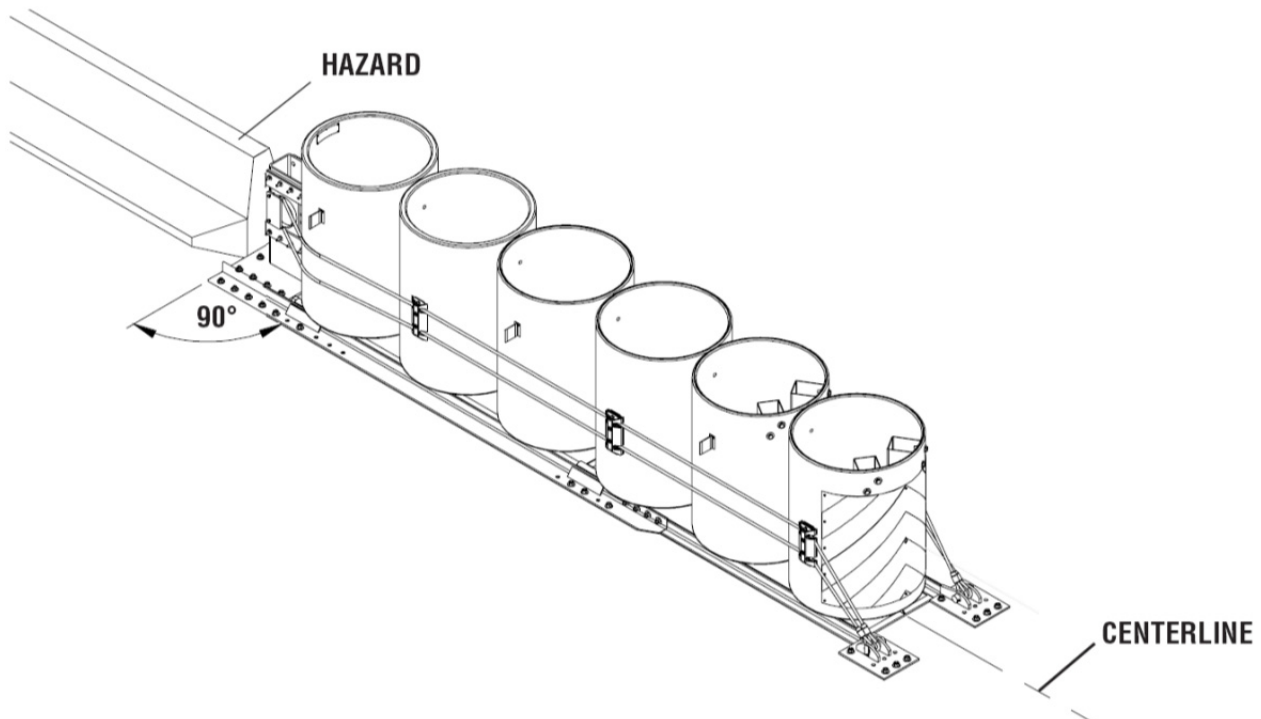
Deploy the appropriate work zone safety devices prior to beginning the deployment and keep them present through all phases of the assembly.

### **2) Determining the Basepoint and Centerline**

Typically the basepoint of the REACT 350<sup>®</sup> Narrow will be the midpoint of the roadside obstacle at its front face. This may change if bidirectional traffic or expansion joints are present (see "Offsetting the System" on p. 22).

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<sup>®</sup> Narrow (refer to the drawings provided). This chalk line will become the centerline for the REACT 350<sup>®</sup> Narrow (see Figure 8).

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



**Figure 8**  
**REACT 350<sup>®</sup> Narrow (36") Placement**

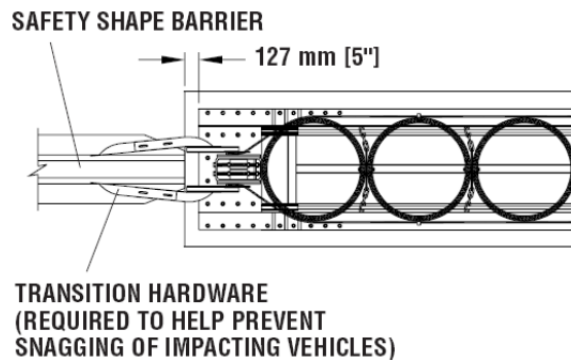
### 3) Lifting/Placing the System

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<sup>®</sup> Narrow into place (see Figure 10).

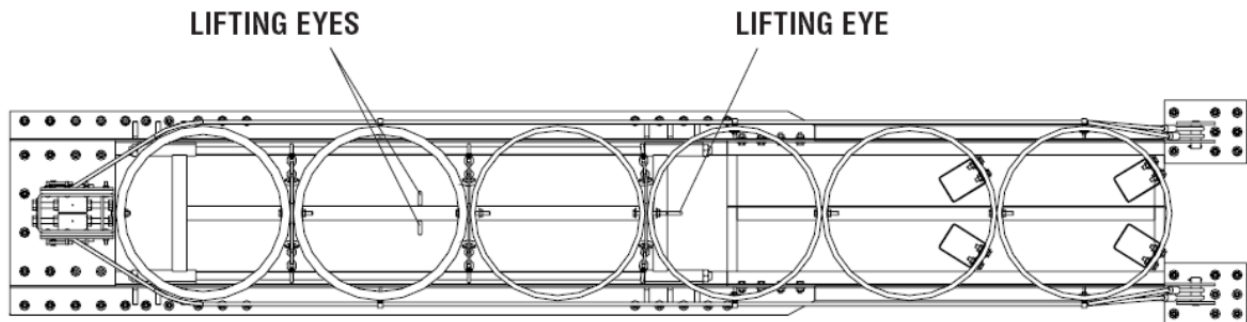
Use fixed-length slings with a 2,722 kg [6,000 lb.] minimum capacity. Fixed slings will prevent system tipping. Do not lift overhead. Measure the deployment from the centerline to ensure that the REACT 350<sup>®</sup> Narrow is centered and at the proper angle. The steel base track will rest flush against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

For Self-contained Backup Assemblies requiring Transition hardware to concrete wall or safety shape barrier, the Steel Base Track should be 127 mm [5"] forward of the roadside obstacle face (see Figure 9).

**Note:** For systems with Concrete Backup (see p. 17).



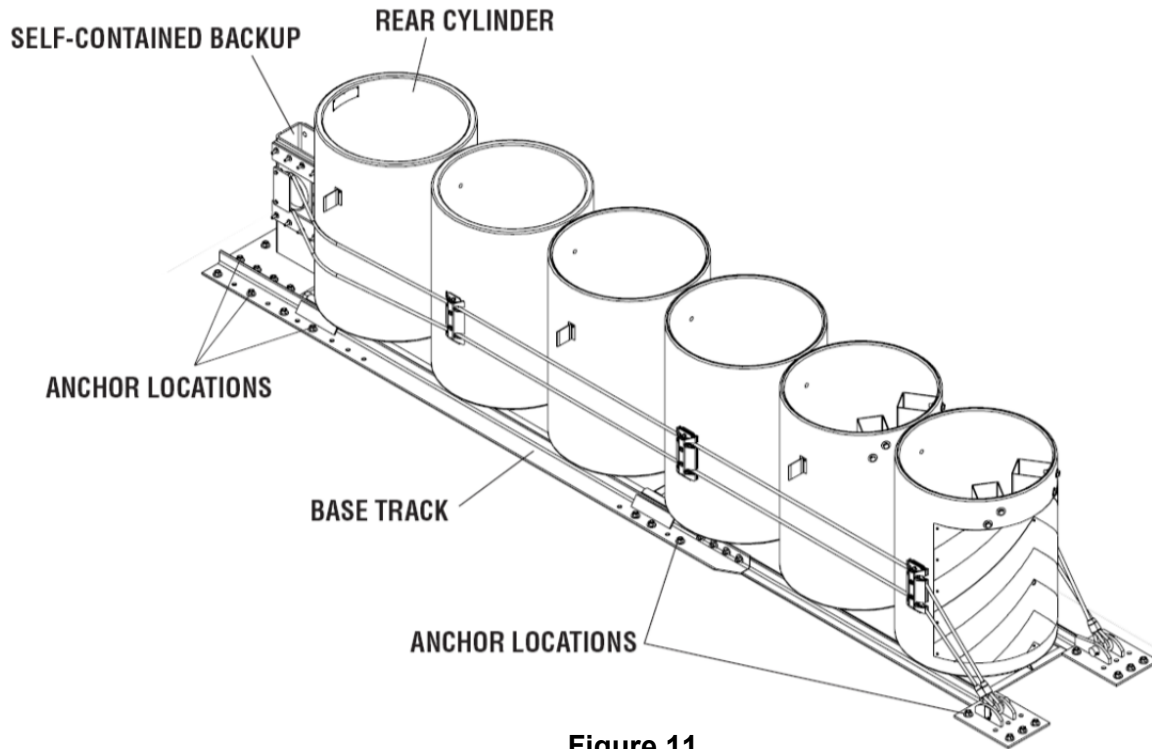
**Figure 9**  
**Base Track Location**



**Figure 10**  
**Lifting Eye Locations**

#### 4) Drill and Set Anchors

Use the holes in the base track as a template to locate and drill fifty-six (56) holes, 22 mm [7/8"] diameter x 140 mm [5 1/2"] deep into the concrete pad or roadway surface (see Figure 11). **All holes in base plate must be used to anchor the REACT 350® Narrow to the foundation.** Use the vertical MP-3® kits to assemble 3/4" diameter x 7" long studs using instructions included with kit. After grout is hardened, use 3/4" flat washers and nuts provided with kit to anchor base track to foundation.



**Figure 11**  
**Anchoring the System**

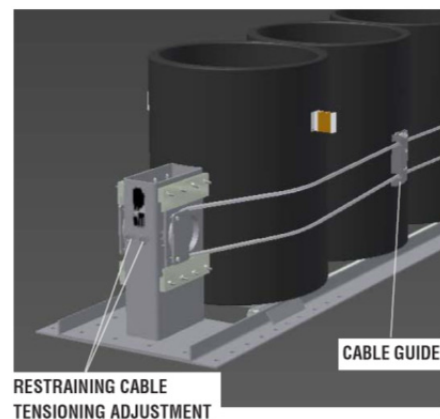


**Warning:** Once the grout has hardened, torque nuts per Table A on page 26. Refer to Table B on page 28 for hardening times.

#### 5) Tension Restraining Cables

Use the two adjusting nuts at the rear of the Backup to tension the cables (see Figure 12).

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

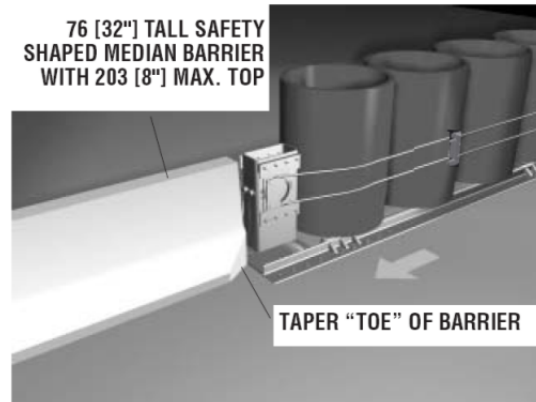


**Figure 12**  
**Restraining Cable Adjustment**



## 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 330 mm [13”]. This helps prevent interaction of wheels on impacting vehicles (see Figure 13 for Transition Panels removed for clarity).

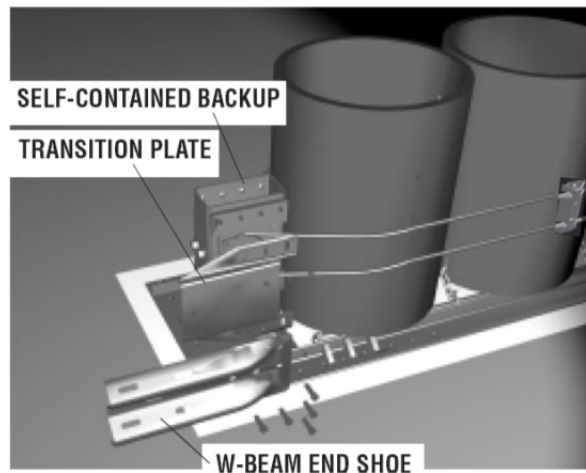


**Figure 13**  
**REACT 350<sup>®</sup> Narrow (36”) with Self-Contained Backup Shielding Safety Shape Barrier**

## Bidirectional Traffic

### Self-Contained, Steel Backup

If a REACT 350<sup>®</sup> 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<sup>®</sup> Narrow. A folded Transition Plate and w-beam connector can mount to either or both sides of the Backup Assembly (see Figure 14). Special post spacing, rail, and rub rail will be required for guardrail.



**Figure 14**  
**Transition Hardware**

## **Concrete Backup Assembly**

**Note:** The Drawing Package supplied with the REACT 350<sup>®</sup> 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<sup>®</sup> Narrow is deployed.

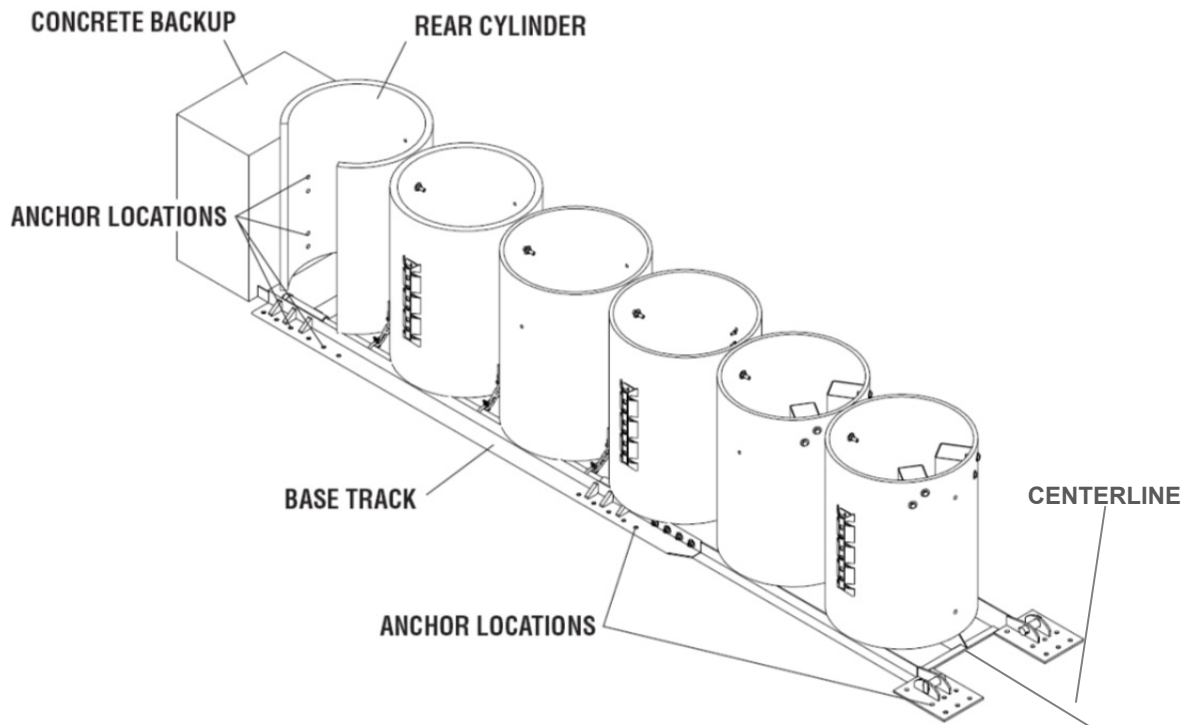
Deploy the appropriate work zone safety devices prior to beginning the deployment and keep them present through all phases of the assembly.

### **2) Determining the Basepoint and Centerline**

Typically the basepoint of the REACT 350<sup>®</sup> Narrow will be the midpoint of the roadside obstacle at its front face. This may change if bidirectional traffic or expansion joints are present (see “Offsetting the System” on p. 22).

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<sup>®</sup> Narrow (refer to the drawings provided). This chalk line will become the centerline for the REACT 350<sup>®</sup> Narrow (see Figure 15).

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



**Figure 15**  
**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<sup>®</sup> Narrow into place (see Figure 10).

Use fixed-length slings with a 2,722 kg [6,000 lb.] minimum capacity. Fixed slings will prevent system tipping. Do not lift overhead. Measure the deployment from the centerline to ensure that the REACT 350<sup>®</sup> 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 140 mm [5-1/2"] deep into the Concrete Backup (see page 17). Use horizontal MP-3<sup>®</sup> kit to assemble the 3/4" diameter x 8-1/2" long studs using instructions included with kit. After grout is hardened, use 3/4" nuts and flat washers included with MP-3<sup>®</sup> kits to attach Cylinder assembly to Concrete Backup (see Figure 15).

### 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 140 mm [5 1/2"] deep into the concrete pad or roadway surface (see Figure 15). **All holes in Base Track must be used to anchor the REACT 350<sup>®</sup> Narrow to the foundation.** Use vertical MP-3<sup>®</sup> kits to assemble 3/4" diameter x 7" long studs using instructions included with kit. After grout is hardened, use 3/4" nuts and flat washers included with MP-3<sup>®</sup> kits to anchor base track to foundation.



**Warning:** Once the grout has hardened, see Table B on page 28 for hardening times and torque to Table A specifications on page 26.

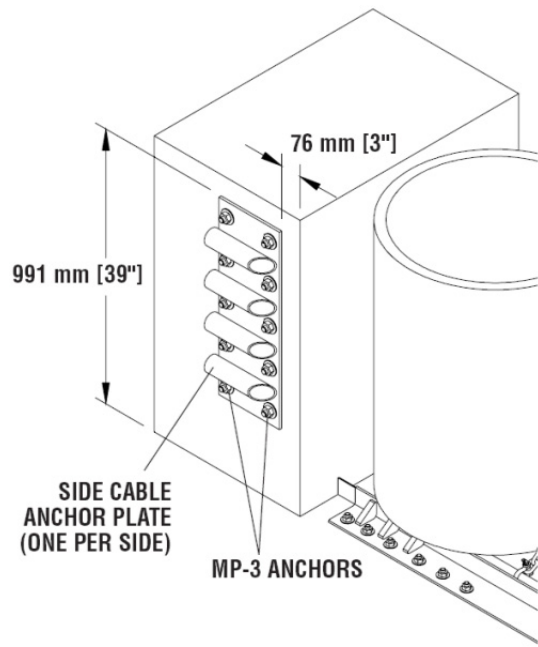
### 6) Drill and Set Side Anchor Plate Anchors

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



**Caution:** The vertical placement of the Side Anchor Plates is critical to the performance of the REACT 350<sup>®</sup> Narrow. If an existing Backup is not tall enough to fulfill these requirements, special brackets are available. Consult Trinity Highway (see p. 3).

When properly deployed, the top of the Side Cable Anchor Plates should be 991 mm (39") from the road surface. The front edge of the Side Cable Anchor Plates should be 76 mm [3"] 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 (see page 19). Use the holes in the Side Cable Anchor Plates as templates to match drill ten (10) holes per side of Backup, 22 mm [7/8"] diameter x 140 mm [5 1/2"] deep into the Concrete Backup. Use horizontal MP-3<sup>®</sup> kit to assemble the (20) 3/4" diameter x 6 1/2" long studs using instructions included with kit. After grout is hardened, use 3/4" nuts and flat washers included with MP-3<sup>®</sup> kit to attach Side Cable Anchor Plates, one for each side, to Concrete Backup (see Figure 16 on p. 19).



**Figure 16**  
**Side Cable Anchor Plates**

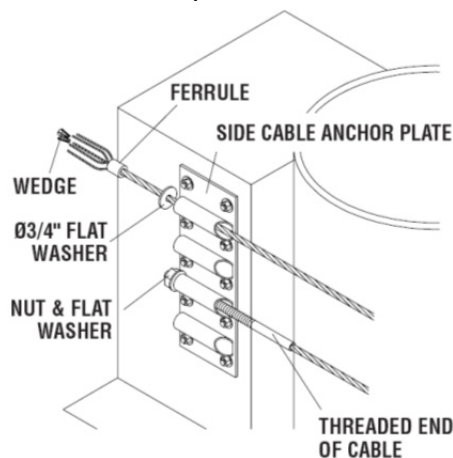


**Warning:** Once the grout has hardened, see Table B on page 28 for hardening times and torque to Table A specifications on page 26.

## 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 (see Figure 17). 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, back through the Top Cable guides of the Cylinders, and through the Top Cable Guide of the Side Plate (see Figure 17).
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 between the two halves of the wedge. Carefully wrap the remaining 6 strands into the slots around the wedge then push into ferrule to tighten (see Figure 17 and detail A). Use a drift pin and sledge hammer to seat the ferrule into the cable receptacles.

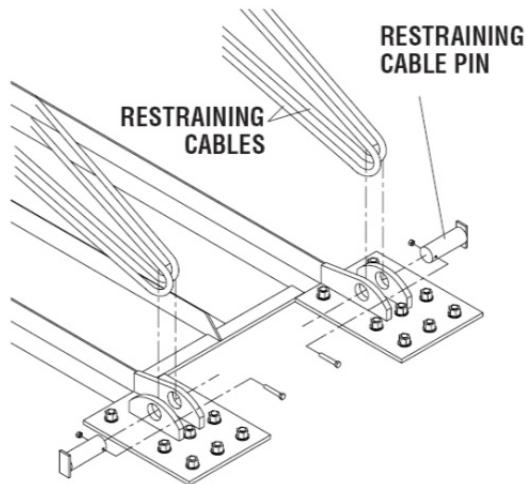


**Figure 17**  
**Routing First Cable**

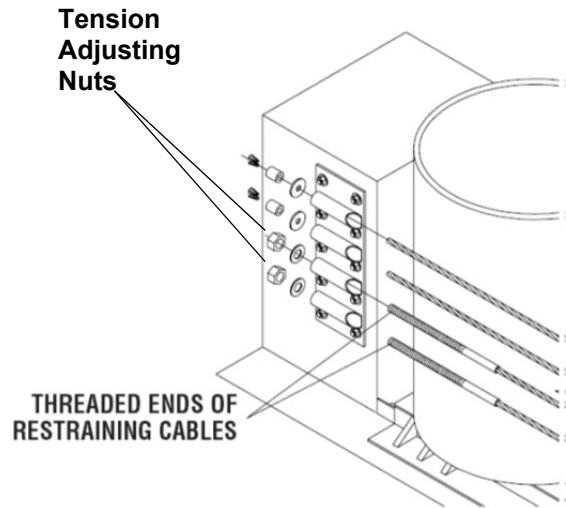


**detail A**  
**Cable Ferrule**

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 in Figure 19 on page 21.



**Figure 18**  
**Front of System Cable Attachment**  
**(Concrete Backup)**



**Figure 19**  
**Rear of System Cable Attachment**  
**(Concrete Backups)**

**8) Tension Restraining Cables**

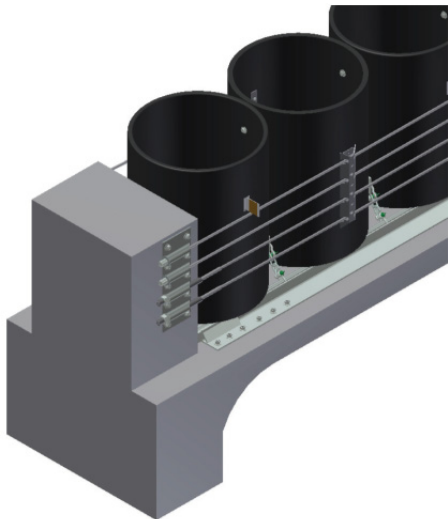
Use the nuts on the threaded end of the Cables to tension the cables (see Figure 19).

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

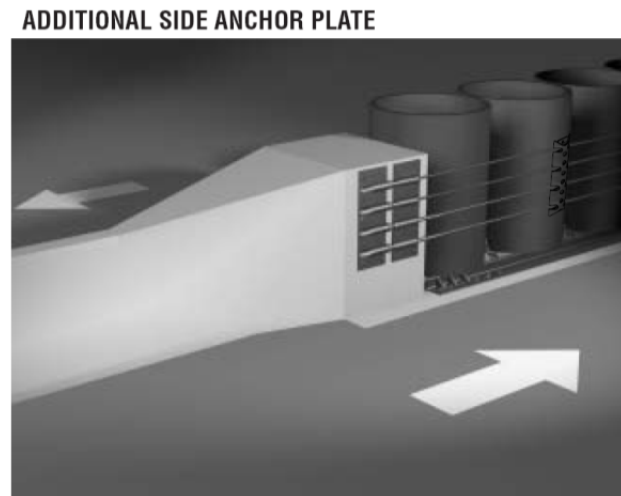
**Bidirectional Traffic**

**Concrete Backup**

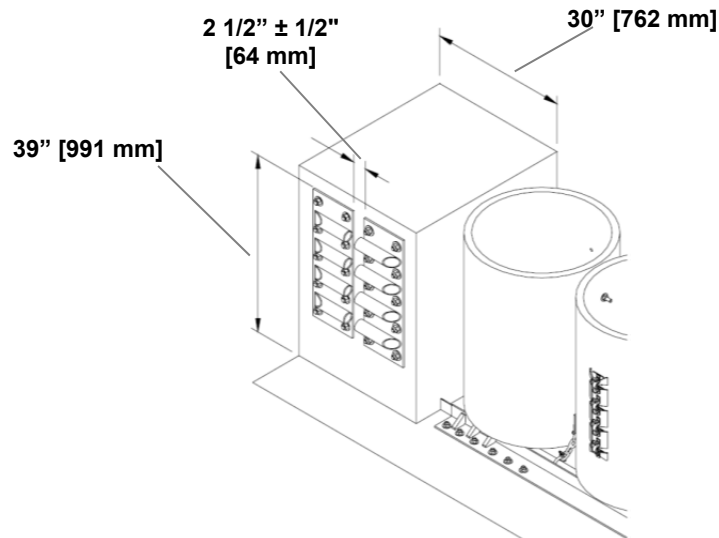
If a REACT 350® Narrow (36") with Concrete Backup is placed in a location where traffic will be approaching from the rear, the Backup should not protrude beyond the roadside feature being shielded. Concrete tapering may be required. Also, an additional standard Side Anchor Plate should be rotated 180 degrees and placed behind the first Anchor Plate (see Figures 21 and 22). In this case, the Backup must be 762 mm [30"] long. Refer to Figure 22 on page 22 for placement and Step 6 on page 18 for anchoring information.



**Figure 20**  
**Restraining Cable Adjustment**  
**(Concrete Backup)**



**Figure 21**  
**Transitioning to the REACT 350®**  
**Narrow (36") with Concrete Backup**



**Figure 22**  
**Assemble additional Anchor Plate for**  
**Bidirectional Traffic**

**Roadside Obstacle Width**

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

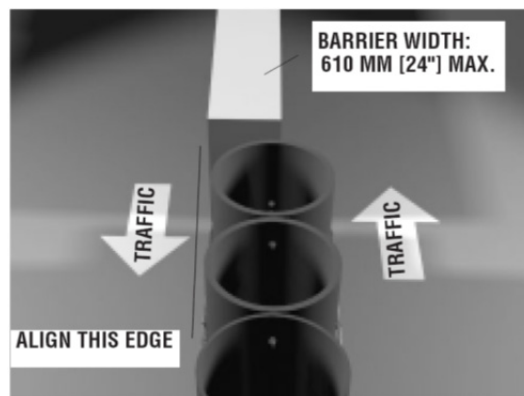
The REACT 350® Narrow with Self-contained Backup may shield roadside features up to 610 mm [24"] (see "Offsetting the System" below).

**Offsetting the System**

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 200 mm [8"]
- 2) If bidirectional traffic is present

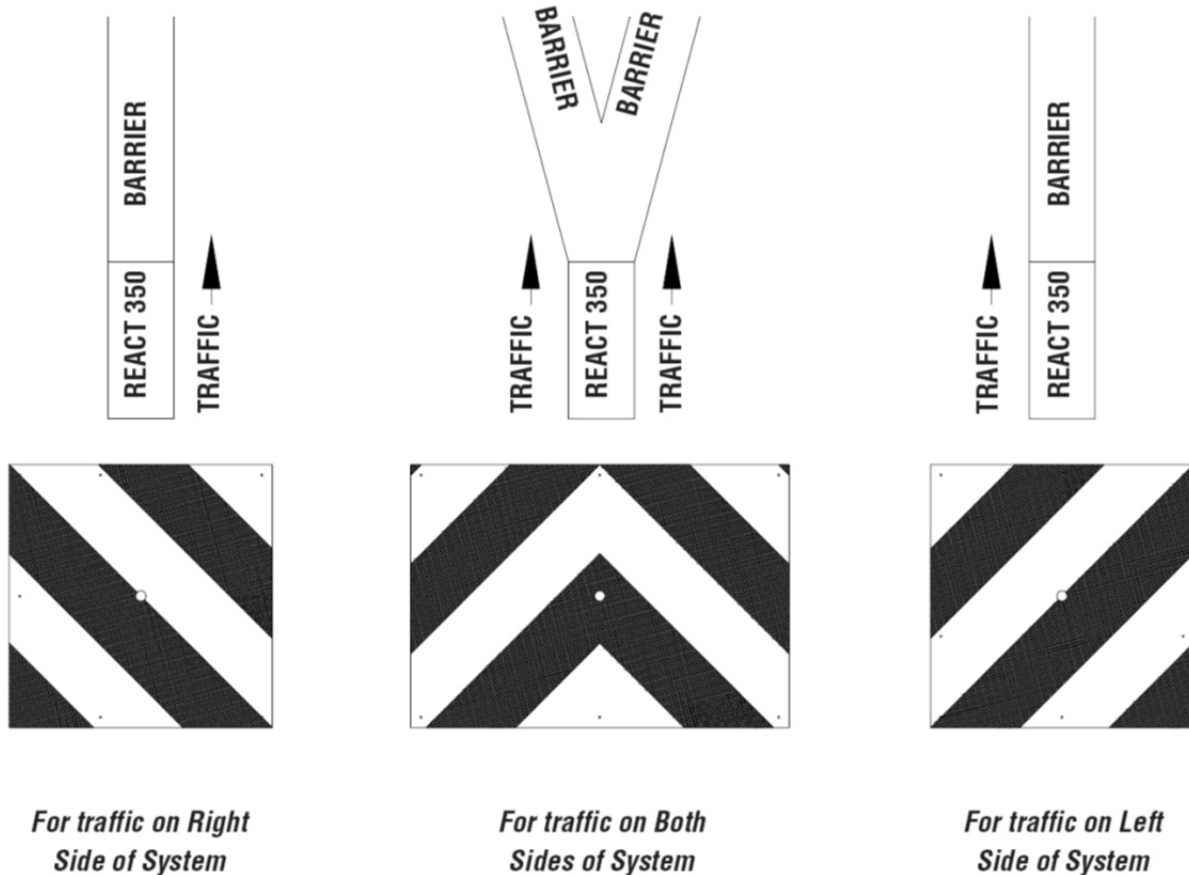
When offsetting the REACT 350® Narrow, align the vertical face of the Backup structure with the face of the barrier (see Figure 23). With this method, REACT 350® Narrow with Self-contained Backup may shield roadside obstacles up to 610 mm [24"]. If a wider obstacle is present, a Concrete Backup may be required. Contact Trinity Highway Customer Service Department if you have questions concerning Concrete Backup requirements (see p. 3).



**Figure 23**  
**Offsetting the REACT 350® Narrow**

## Attach Nose Cover

1. Ensure the nose cover suits the site (see Figure 24 – Nose Cover Selection below). Refer to local standards and “Manual on Uniform Traffic Control Devices” (MUTCD) for nose.



**Figure 24  
Nose Cover Selection**

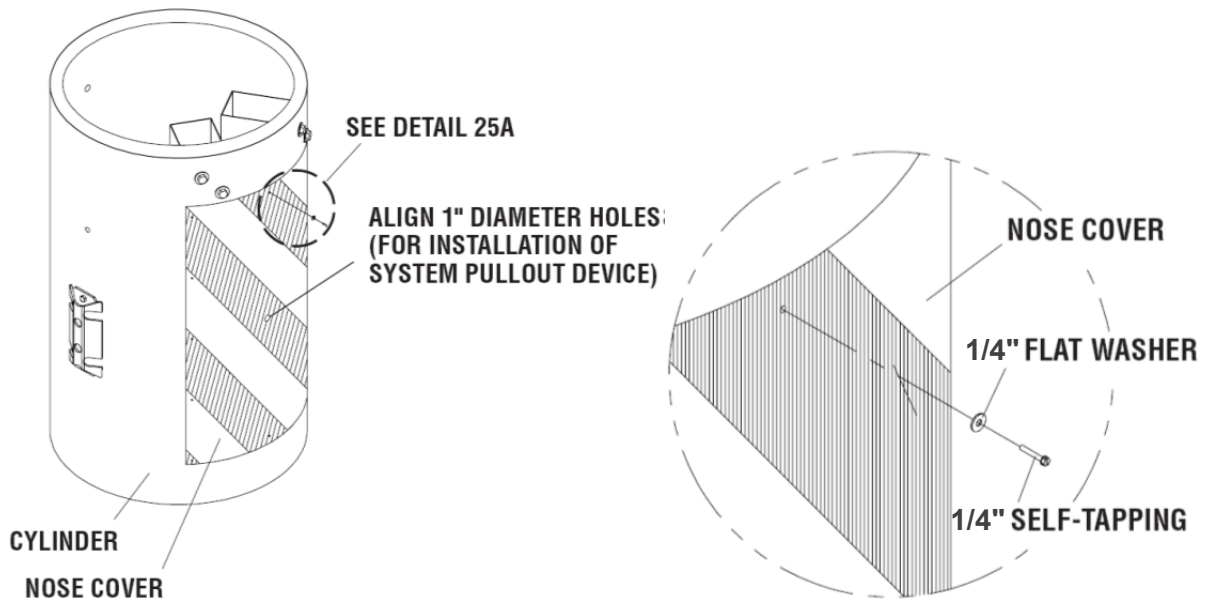
2. Align 1” diameter hole in nose cover with 1” diameter hole in Cylinder.
3. Screw 1/4” self-tapping screw into Cylinder punching through reflective tape and the existing holes in nose cover until head of fastener is flush for all 12 places (see Figure 25 on p. 24).

### **Attach Side Mount Reflectors**

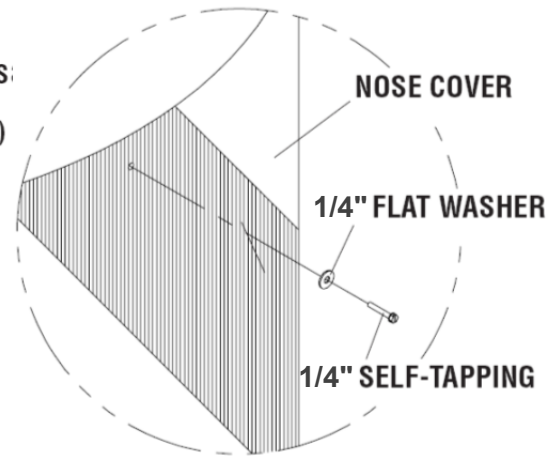
Refer to local standards and “Manual on Uniform Traffic Control Devices” (MUTCD) for Reflectors.

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 (see Figure 26 on p. 24).

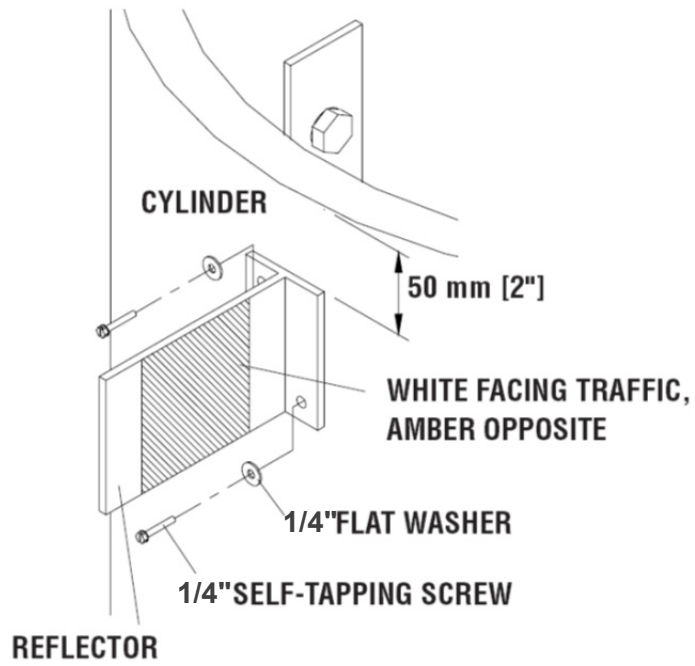




**Figure 25**  
**Nose Cover Assembly**



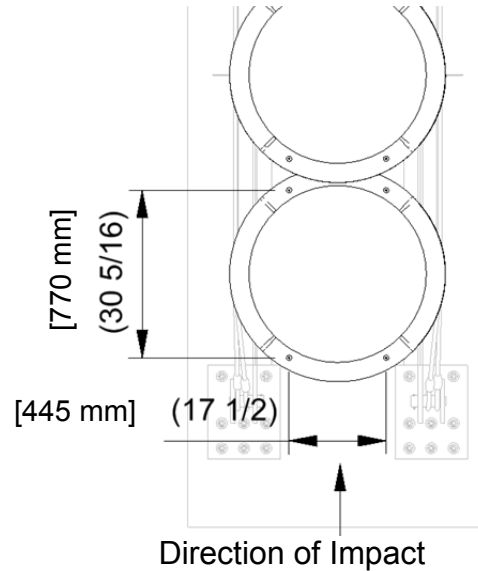
**detail 25A**



**Figure 26**  
**Side Mounted Reflector**

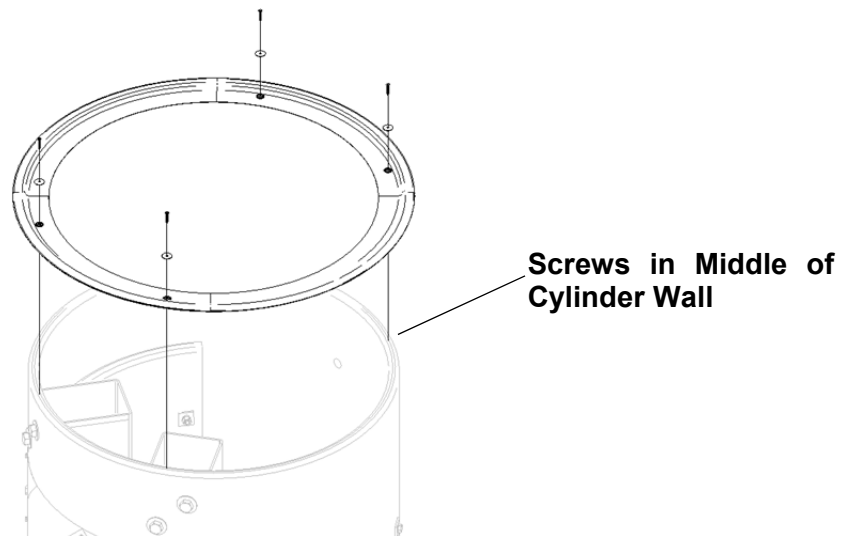
## Optional Debris Covers

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 (see Figure 27).



**Figure 27**

Next attach the four (4) #10 flat head self-tapping screws and fender washers, ensuring all screws are positioned in the middle of the Cylinder wall (see Figure 28).



**Figure 28**

Continue to attach the remaining covers as described above.

**Note:** The covers may overlap; however, the overlap direction is not critical to system performance.

## **MP-3<sup>®</sup> Polyester Anchoring System**

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

Each MP-3<sup>®</sup> kit contains a can of MP-3<sup>®</sup> resin, hardener, cold-weather promoter, studs, washers, nuts and a complete safety sheet. The cold-weather promoter shortens hardening time by as much as seven hours. Both vertical and horizontal assemblies are possible using the MP-3<sup>®</sup> system.

### **Vertical Assemblies**



**Warning:** Do not allow the MP-3<sup>®</sup> resin or hardener to contact skin or eyes. See material safety data sheet available for the MP-3<sup>®</sup> kit for first-aid procedures. Use only in well-ventilated area. Do not use near open flame.



**Warning:** Wear safety goggles, apron, and gloves during application.

**Note:** Read MP-3<sup>®</sup> Instructions before starting.

#### **1) Prepare the Concrete Pad**

The anchor bolts (studs) that anchor the REACT 350<sup>®</sup> Narrow system Backup and/or base track sections to the Concrete Pad must be those shipped in the kit or of high strength steel with 830 MPa [120,000 psi] minimum tensile strength or equivalent. These studs must be set in minimum 28 MPa [4000 psi] concrete. Allow the concrete to cure a minimum of seven days before drilling the anchor holes or applying MP-3<sup>®</sup>.

#### **2) Drill Holes**

**Note:** Trinity Highway recommends using double-fluted drill bits to achieve optimum tensile strength when applying the MP-3<sup>®</sup> anchoring system.

Use the part that is to be anchored as a drilling template. Drill the holes 3 mm [1/8"] larger than the stud diameter to the recommended depth, using a rotary hammer drill. If a diamond drill bit is used, the surface will be too smooth for the MP-3<sup>®</sup> to adhere and full strength will not be achieved. Refer to the MP-3<sup>®</sup> assembly instructions provided with your kit. Check to be sure all the holes are drilled to the proper depth and aligned with the part to be anchored.

**Table A**  
**MP-3<sup>®</sup> Anchoring Information**

<b>Stud Size:</b>	<b>Concrete Bit Size</b>	<b>Minimum Depth</b>	<b>Recommended Torque</b>
6 1/2"	22 mm [7/8"]	140 mm [5-1/2"]	165 N-m [120 ft-lb]
7-1/2" & 8-1/2"	22 mm [7/8"]	140 mm [5-1/2"]	165 N-m [120 ft-lb]
18"	22 mm [7/8"]	420 mm [16-1/2"]	15 N-m [10 ft-lb]



**Important:** When mounting on asphalt, initial torque shall be as shown in Table A. Due to the instability of asphalt, anchors may loosen over time. For this reason Trinity Highway recommends anchoring to asphalt only at temporary locations. It is recommended to re-torque anchors in asphalt every 6 months to the proper initial torque specified.

### 3) Clean the Holes

Blow the concrete dust from the hole using oil-free compressed air. Thoroughly brush it with a stiff-bristled brush and then blow it out again. If the hole is wet, completely flush it with water while brushing then blow it clean using oil-free compressed air.

### 4) Mix the Resin and Hardener

Wearing apron, gloves and safety goggles, remove the lids from the MP-3<sup>®</sup> Part A-resin and Part B-hardener containers. Pour Part B into Part A then mix vigorously for 30 seconds to form MP-3<sup>®</sup> grout (an anchor stud may serve as a stirring rod).

### 5) Add Cold-Weather Promoter (in Cold Weather)

For faster hardening in cold weather, promoter may be used. Add the entire contents of the partially filled promoter container to the MP-3<sup>®</sup> grout then mix for an additional 30 seconds. Use immediately because the MP-3<sup>®</sup> grout will thicken quickly. Refer to page 28 for hardening times.



**Warning:** Do not use promoter when the temperature is above 15 degrees Celsius (60 degrees Fahrenheit). Grout will harden too quickly. Use only in well-ventilated area. Do not use near open flame.

### 6) Pour Grout into Holes

Crimp the mouth of the can to form a sprout and pour the MP-3<sup>®</sup> grout mixture down into the hole through the part. Fill the hole to 1/3 - 1/2 full.



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

### 7) Add the Washers and Nuts

Place a flat washer and nut on the stud leaving nut flush with the end of the stud.

### 8) Insert Studs in Holes and Wait for Grout to Harden

Push the stud down through the part to be anchored and into the hole. Give the stud several twists in the MP-3<sup>®</sup> to wet the threads.



**Caution:** Do not disturb or load the stud until the MP-3<sup>®</sup> material has hardened (see Table B on p. 28).

### 9) Torque the Nuts

Once the grout has hardened, torque the nut per Table A on page 26.

**Table B**  
**Approximate Hardening Times in hours**

Temperature		Hardening Times (hours)	
(C)	(F)	No Promoter	With Promoter
>26	>80	1/2	N/R*
22-26	70-79	1	N/R
16-21	60-69	2	N/R
10-15	50-59	4	3/4
4-9	40-49	8	1
-1-3	30-39	N/R	1 1/2
<-1	<30	N/R	N/R**
*Not recommended			
**Contact Customer Service Department for more information			

## **MP-3<sup>®</sup> Horizontal Assemblies**

The horizontal MP-3<sup>®</sup> kit is the same as the vertical kit except that a cartridge for a standard caulking gun is supplied in the horizontal kits and the resin for the horizontal kits is a thixotropic (TX) resin. The TX-Resin is a gelled resin intended to keep the grout in place in horizontal holes during application.

When using the horizontal MP-3<sup>®</sup> kits follow the vertical instructions with the following exceptions:

### **1) Thread Dispensing Tip onto Dispenser**

Prior to mixing the grout, carefully thread the dispensing tip onto the dispenser.

### **2) Pour Mixed Grout into Dispenser**

Once the grout is mixed, crimp the mouth of the can to form a spout and pour the MP-3<sup>®</sup> grout into the open end of the dispenser (use mixing stud to scrape out the portion remaining in the can). You may use the box to hold the dispenser upright. Close the box lid and poke the dispenser tip into the top of it. Seal the dispenser with the plunger provided.

### **3) Place Dispenser in Caulking Gun and Dispense Grout**

Cut the small end of the dispenser tip off. Place the dispenser into a caulking gun and dispense until MP-3<sup>®</sup> TX grout reaches the tip of the dispenser then release pressure. Push the dispenser tip through the part to the bottom of the hole and dispense while slowly withdrawing the tip.



**Caution:** Do not overfill or under fill the hole. Fill hole approximately 1/3 to 1/2 full. If the hole is overfilled, there will not be enough grout to use all of the anchor studs/kit. If hole is under filled, the grout may not develop the required pull-out strength.

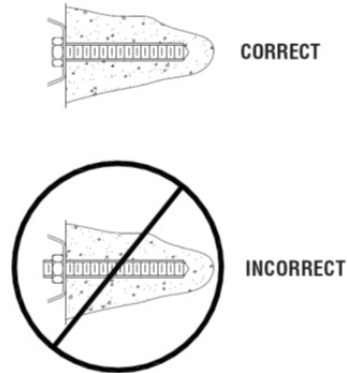
**4) Add the Washers and Nuts**

Put washer and nut on stud, leaving nut flush with end of stud (see Figure 29).

**5) Insert Studs into Holes**

Push stud through part to be anchored and into hole. Twist the stud in the MP-3® grout to wet the threads.

**Note:** In horizontal applications the stud should be flush with the top of the nut (see Figure 29).



**Figure 29**  
**MP-3® Horizontal Application**



**Caution:** Do not disturb or load the stud until the MP-3® material has hardened (see Table B on p. 28).

**6) Torque the nuts**

Once the grout has hardened, torque nuts per Table A on page 26.

## **MP-3<sup>®</sup> Assembly Cautions**

### **1) Shelf life**

If the shelf life of the MP-3<sup>®</sup> has expired (see MP-3<sup>®</sup> kit for expiration information), mix a small amount of MP-3<sup>®</sup> in the proportions of one part A to two parts B by volume. If the material does not set according to the instructions, replace with new MP-3<sup>®</sup> that is within shelf life.



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

### **2) Steel rebar**

If steel rebar is encountered while drilling an MP-3<sup>®</sup> anchor bolt hole, 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 hole depth is reached.



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

- B) Drill a new hole down at an angle past the rebar to the proper depth. Anchor the stud by completely filling both holes with MP-3<sup>®</sup>.

## **Maintenance and Repair**

The REACT 350<sup>®</sup> system, through crash testing, has been shown to be a potentially reusable crash cushion. After those impacts observed within NCHRP Report 350 criteria, it has been observed that, potentially, the bulk of the system can be reused. However, whether or not a system is reusable is the sole discretion of the highway authority specifying their use.



**Warning:** After an impact, always follow the “Post-Impact Instructions” on page 34.

### **Estimated Time for Maintenance**

An experienced two-person crew with the proper tools and spare parts should be able to complete the work in one to three hours depending on the damage done to the system.

### **Life Expectancy**

#### **Environment**

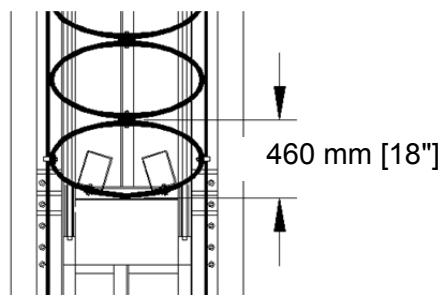
It is anticipated, given typical environmental conditions that the plastic cylinders will survive in a highway environment for a period ranging from 5 to 15 years from the date of deployment unless impact damage renders them otherwise. However, the life of a system in each specific application should be determined by the highway authority specifying their use and maintaining the system.

#### **Impacts**

Potential life expectancy of the system is also dependent on the impacts. This includes:

1. The number of impacts to the system
2. The severity of the impacts
3. The temperature at the time of the impacts

The REACT 350<sup>®</sup> system 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 460 mm [18"] or less (see Figure 30) 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 Trinity Highway parts (see p. 3).



**Figure 30 - Measure Minor Axis**



## Recycling Information

When parts need to be replaced, it is recommended that the old parts be recycled as follows:

Steel should be sold as scrap to a local metal recycler.

HDPE plastic cylinders should be sold to a plastic recycler if available. If a recycler is unavailable, dispose of the material as plastic refuse.

## Parts Ordering Procedure

1. Locate the Product Decal attached to the inside of the Rear Cylinder. Copy the sales order information from the decal.
2. Make a list of any damaged parts, using part numbers and descriptions found on the reference drawings included with the REACT 350<sup>®</sup> system.
3. Only parts specified to be used in this system may be used during repair. The use of a part not specified in this system design renders this system as one that HAS NOT BEEN accepted by FHWA for use on the National Highway System and all observed crash testing to determine system performance is negated. The use of a part not contained herein during the repair renders the systems as something other than that which was tested and accepted by the FHWA for use on the national highway system.

## Inspections

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” on page 34.

## Visual Drive-By Inspection

1. Check to see if there is evidence of an impact. Check to verify that the REACT 350<sup>®</sup> system 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<sup>®</sup> system 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<sup>®</sup> system 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.

## Walk-Up Inspection

1. Check for any foreign matter that may interfere with the smooth operation of the REACT 350<sup>®</sup> system. Check for and remove any debris found inside the Cylinders. Check for and remove any debris found under and around the REACT 350<sup>®</sup> system.
2. Check for evidence of bent or damaged parts. Replace as soon as possible (see “Parts Ordering Procedure” on page 32).
3. Verify that all nuts and bolts are tight and rust free.
4. Be sure MP-3<sup>®</sup> Concrete Anchor Bolts are securely anchored.
5. Verify that all Cylinders are in good condition and properly positioned on the Base Track. Any Cylinder that is cracked or otherwise damaged should be replaced. Measure the minor axis of the Cylinders. Cylinders require replacement when the minor axis of the cylinders measures 460 mm [18”] or less (see Figure 30 on page 31).
6. Ensure all cables are attached with parts specified for use in this system.
7. Note the location and condition of the REACT 350<sup>®</sup> system 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<sup>®</sup> system.

## Post-Impact Instructions

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

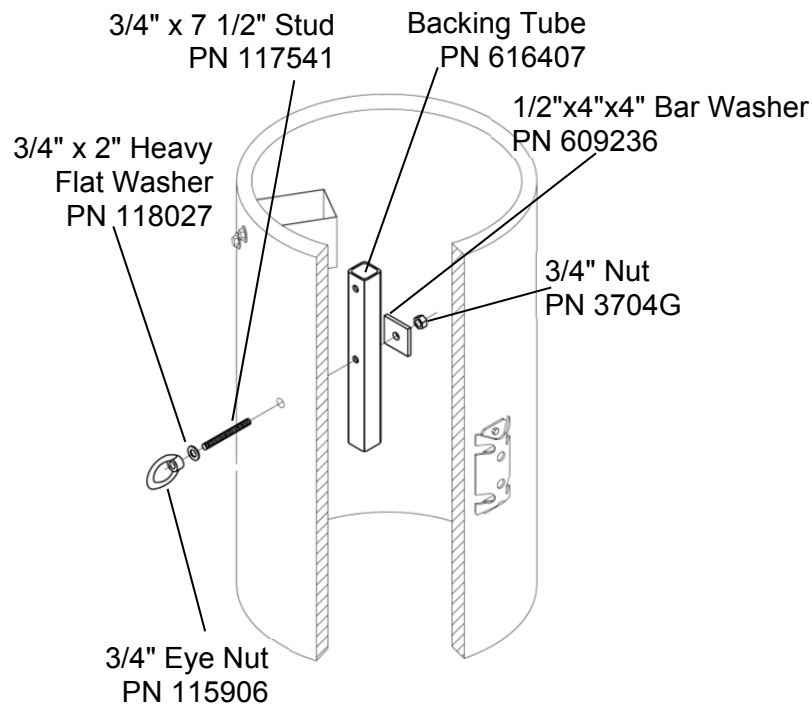


**Warning:** The correct safety equipment and approved traffic management must be used as required for walk-up inspections of the REACT 350<sup>®</sup> system.

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 460 mm [18"] threaded rods.

3. Clear and dispose of any debris inside the cylinders and on the 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 when the minor axis of the Cylinders measures 460 mm [18"] or less (see Figure 30 on p. 31).
5. The REACT 350<sup>®</sup> system 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 (see Figure 31).



**Figure 31 - Pullout Assembly**

# Drawing Request Form

(Please copy this form)

Created by \_\_\_\_\_ Date Submitted \_\_\_\_\_

Company \_\_\_\_\_ Drawings Required by \_\_\_\_\_

Site Location / Title \_\_\_\_\_

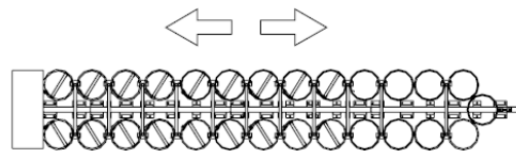
City/County \_\_\_\_\_ State/Country \_\_\_\_\_

Location of hazard:

Median       Gore       Roadside       Toll       Other

Temporary/Construction Zone or Permanent

Direction of traffic (circle all appropriate arrows)



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

Design Speed of Roadway \_\_\_\_\_ (mph or km/h)

Foundation  Grade,  Deck structure,  Continuous concrete pavement

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.

Does curbing exist?  No,  Yes If yes, what is the curb height?

Is cross slope greater than 8%?  No,  Yes If yes, what is the slope?

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.)

Number of impacts expected per year? \_\_\_\_\_

Drawings requested

Quantity \_\_\_\_\_ Drawing Size (11x17 unless specified)

Set       Cover Sheet Only       Cover sheet and Concrete Work

# Order Form

(Please copy this form)

Bill To: \_\_\_\_\_

Date: \_\_\_\_\_ Order No. \_\_\_\_\_

\_\_\_\_\_

Job No. \_\_\_\_\_

\_\_\_\_\_

Job Name: \_\_\_\_\_

Ship To: \_\_\_\_\_

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:**

**Notes:**



# TRINITY

## HIGHWAY

*Ahead of the Curve™*

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