

**ET Plus<sup>®</sup> 350**  
Guardrail End  
Treatment

**Assembly Manual**

Part No. 620292B

Revised March 2010



**TRINITY**  
HIGHWAY PRODUCTS  
ENERGY ABSORPTION SYSTEMS

# ET-PLUS™ Systems



## Guardrail End Treatment

### Instructional Manual



Trinity Highway Products, LLC.  
2525 Stemmons Freeway  
Dallas, Texas 75207



**IMPORTANT:** These instructions are to be used only in conjunction with the installation of the ET-PLUS™ systems. These instructions are for standard installations specified by the appropriate state/specifying agency. In the event the specified systems installation requires or involves special circumstances, contact the appropriate state/specifying agency before proceeding. Trinity Highway Products, LLC. representative is available for consultation, if required.

**This Manual must be available to the workers at all times. For additional copies, contact Trinity Highway Products, LLC. at 800-527-6050.**

All information, illustrations, and specifications in this Manual are based on the latest ET-PLUS™ systems information available at the time of printing. We reserve the right to make changes at any time.

## CUSTOMER SERVICE CONTACTS

Trinity Highway Products, LLC is committed to the highest level of customer service. Feedback regarding the ET-PLUS™ systems, their installation procedures, supporting documentation, and performance is always welcome. Our goal is to enhance highway safety through innovation. Additional information for materials and product specifications can be obtained by calling the telephone numbers or writing to the email address below:

<b>TRINITY HIGHWAY PRODUCTS, LLC:</b>	
Telephone:	800-644-7976 (U.S. Calls) +1-214-589-8140 (International)
E-mail:	productinfo@trin.net
<b>REGIONAL TELEPHONE CONTACTS:</b>	
Dallas, Texas	800-527-6050
Centerville, Utah	800-772-7976
Elizabethtown, Kentucky	800-282-7668
Girard, Ohio	800-321-2755
Orangeburg, South Carolina	800-835-9307

## SUGGESTED SAFETY RULES FOR INSTALLATION - MAINTENANCE - REPAIR

### \* IMPORTANT SAFETY INSTRUCTIONS \*

Always keep this Manual in a location where it is easily accessed by persons who install, maintain, or repair the ET-PLUS™ systems.

### SAFETY SYMBOLS

Below are the safety symbols that may appear on the ET-PLUS™ systems or in the documentation. Read the entire Manual for suggested safety, assembly, installation, maintenance, repair, and service information.

<b>SYMBOL</b>	<b>MEANING</b>
	<ul style="list-style-type: none"> <li><b>SAFETY ALERT SYMBOL</b></li> </ul> <p>Indicates Danger, Warning, or Caution. Failure to read and follow the Danger, Warning, and Safety or Caution indicators could result in serious injury or death to the workers and/or bystanders.</p>
	<ul style="list-style-type: none"> <li><b>WARNING – READ MANUAL</b></li> </ul> <p>Read the Manual(s) and follow all warnings and safety instructions. Failure to follow this warning could result in serious injury or death to the workers and/or bystanders.</p>

## WARNINGS AND CAUTIONS

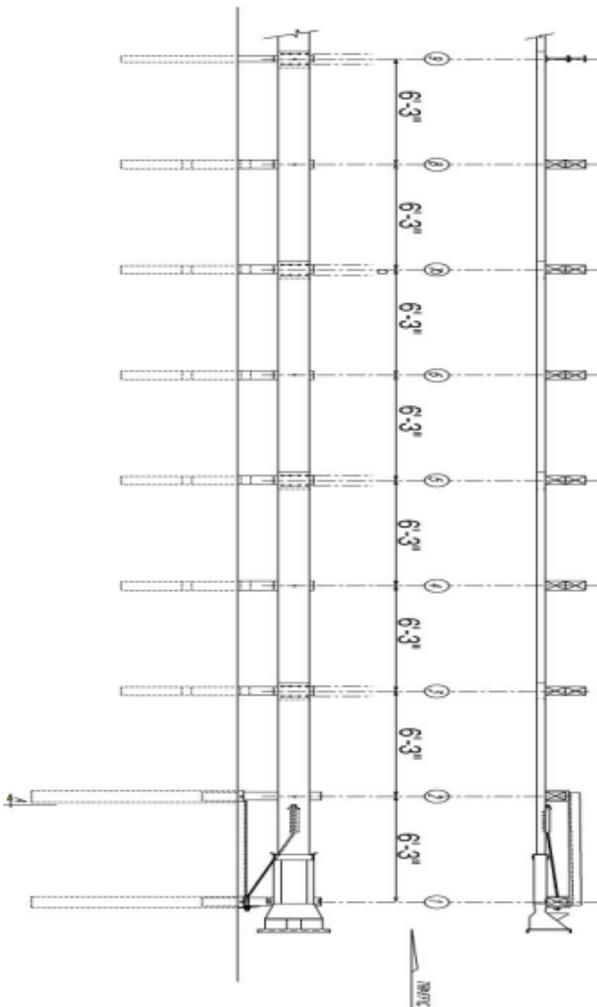
Read all warnings, cautions, and instructions before installing/maintaining/repairing the ET-PLUS™ systems.

	<b>IMPORTANT:</b> READ SAFETY INSTRUCTIONS THOROUGHLY AND FOLLOW THE SAFE OPERATION PRACTICES WHILE INSTALLING THE ET-PLUS™ systems. Failure to follow this warning could result in serious injury or death to the workers and/or bystanders.
	<b>WARNING:</b> Read the instructions carefully. Be familiar with the complete instructions for the ET-PLUS™ systems before installing, maintaining, or repairing the ET-PLUS™ systems. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Ensure that the necessary traffic control is setup and any debris that has encroached onto the traveled way or shoulder has been removed, before beginning installation or repairs. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Be sure adequate time is available for complete installation, before beginning the installation process. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Do NOT perform installation, maintenance, or repair of the ET-PLUS™ systems when tired, ill, or under the influence of alcohol, drugs, or medication. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Do not install, maintain, or repair the ET-PLUS™ systems, until you have read this Manual thoroughly. Please call Trinity Highway Products, LLC at 800-644-7976, if you do not understand the installation instructions. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Use only Trinity Highway Products' parts on the ET-PLUS™ systems for installation, maintenance, or repair. The installation or co-mingling of unauthorized parts is strictly prohibited. Failure to follow this warning could result in 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"). The ET-PLUS™ systems and its component parts have been accepted for state use by FHWA. However, a co-mingled system has not been accepted.
	<b>WARNING:</b> Do NOT modify the ET-PLUS™ systems in any way. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Do NOT perform installation, maintenance, or repair, if the ET-PLUS™ systems site, shoulder, or traveled area is covered or encroached by road debris. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Safety measures, incorporating traffic control devices, must be used to protect all personnel, while at the installation, maintenance, or repair site. Failure to follow this warning could result in serious injury or death to the workers and/or bystanders. .
	<b>WARNING:</b> Ensure that the entire work zone site is visible at all times. Failure to follow this warning could result in serious injury or death to the workers and/or bystanders.
	<b>WARNING:</b> Use caution when working near public roads. Be mindful of vehicles in motion nearby. Failure to follow this warning could result in serious injury or death to the workers and/or bystanders.
	<b>WARNING:</b> Ensure that all Guardrail products and delineation used meet all federal, state/specifying agency, and local specifications. Failure to follow this warning could result in serious injury or death in the event of a collision.

	<b>WARNING:</b> Ensure that your installation, repair, and maintenance meet all appropriate Manual on Uniform Traffic Control Devices (MUTCD) and local standards. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Ensure that the Guardrail you install is terminated, as dictated by the state/specifying agency, pursuant to FHWA acceptance. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Do NOT install SYTP™ at <b>location 1</b> . Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Do NOT install 6'0" CRT post at location 1. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Do NOT bolt the rail panel to the post at <b>location 1</b> in any of the ET-PLUS™ systems. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Do NOT bolt the rail to the HBA™ post at <b>location 2</b> . Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Ensure that there is proper site grading for tube and post placement, as dictated by the state/specifying agency, pursuant to FHWA acceptance. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Ensure that all of the ET-PLUS™ systems Warnings, Cautions, and Important statements within the ET-PLUS™ systems Manual are completely followed. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Always use safety precautions when performing installation, maintenance, repair, mixing chemicals, and/or moving heavy equipment. Wear steel toe shoes, gloves, safety goggles, and back protection. Failure to follow this warning could result in serious injury or death to the workers and/or bystanders.
	<b>WARNING:</b> Ensure all wood blocks or composite blocks used with steel posts are routered. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Ensure that this installation conforms with the guidance provided by the AASHTO Roadside Design Guide, including, but not limited to, those regarding placement on curbs. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Any grout, backfill, or other materials (such as concrete, asphalt, or soil) must be low enough so as not to obstruct, constrain, or otherwise engage the bearing plate. Failure to eliminate the interaction of soil or materials with the bearing plate will hinder the performance of the ET-PLUS™ systems and could result in serious injury or death in the event of a collision.
	<b>CAUTION:</b> Ensure before installing, maintaining, or repairing the ET-PLUS™ systems that no parts are frayed, damaged, or broken. Failure to follow this warning could result in serious injury to the workers and/or bystanders.

**ET-PLUS™ (TL-3)  
50' (15.24 m) SYSTEM**

For specific installation, maintenance, or repair details, refer to the state/specifying agency's standard drawing(s).



(This drawing represents one (1) version of the 50' (15.24 m) systems)

**Alternates for Foundation Tubes**

At post **locations 1 and 2**, the alternates to long foundation tube without soil plate are:

- Hinged Breakaway™ (“HBA™”) post
- Short tube with soil plate
- HBA™ post at **location 1**, Steel Yielding Terminal Post™ (“SYTP™”) at **location 2**
- Long foundation at **location 1**, SYTP™ at **location 2**
- Short foundation with soil plate at **location 1**, SYTP™ at **location 2**

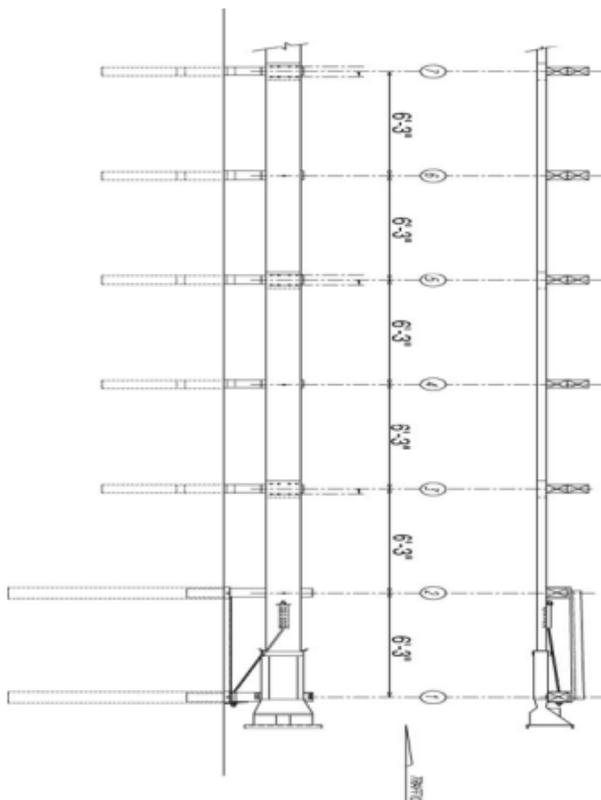
The alternate to two (2) 12' 6" (3.81 m) long rail elements is one (1) 25' 0" (7.62 m) long rail element.

For post **locations 3 through 8** (50' (15.24 m) system), alternates are:

- All short tubes without soil plates and breakaway wood posts
- All HBA™ posts
- All CRT posts
- All SYTP™
- Any combination of above options, as accepted by the FHWA and dictated by the state/specifying agency

**ET-PLUS™ (TL-3)  
37' 6" (11.43 m) SYSTEM**

For specific installation, maintenance, or repair details,  
refer to the state/specifying agency's standard drawing(s).



(This drawing represents one (1) version of the 37' 6" (11.43 m) systems)

**Alternates for Foundation Tubes and Posts**

At post **locations 1 and 2**, the alternates to long foundation tube without soil plate are:

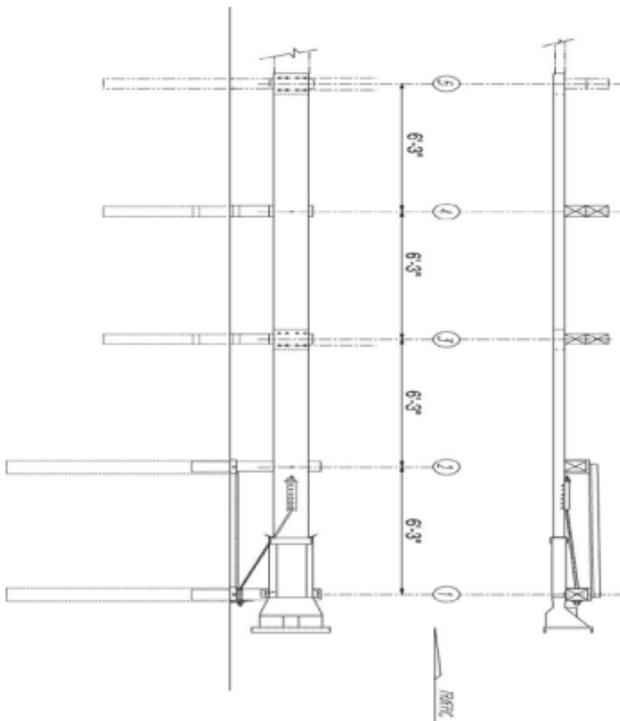
- HBA™ post
- HBA™ post at **location 1** and SYTP™ at **location 2**
- Long foundation tube or short tube with soil plate at **location 1** and SYTP™ at **location 2**

For post **locations 3 through 7** (37' 6" (11.43 m) system), alternates are:

- All short tubes without soil plates and breakaway wood posts
- All HBA™ posts (HBA™ post required at **location 8**)
- All CRT posts
- All SYTP™ (SYTP™ required for **location 8**)
- Any combination of above options, as accepted by the FHWA and dictated by the state/specifying agency

**ET-PLUS™ (TL-2)  
25' (7.62 m) SYSTEM**

For specific installation, maintenance, or repair details,  
refer to the state/specifying agency's standard drawing(s).



(This drawing represents one (1) version of the 25' (7.62 m) systems)

**Alternates for Foundation Tubes, Rail Panels, and Posts**

At post **locations 1 and 2**, the alternates to long foundation tube without soil plate are:

- HBA™ post
- HBA™ post at **location 1** and SYTP™ at **location 2**
- Long foundation tube or short tube with soil plate at **location 1** and SYTP™ at **location 2**

The alternate to two (2) 12' 6" (3.81 m) long rail elements is one (1) 25' 0" (7.62 m) long rail element.

For post **locations 3 through 4** (25' (7.62 m) system), alternates are:

- Short steel foundation tubes without soil plates and breakaway wood posts or SYTP™ in tubes
- All HBA™ posts
- All CRT posts
- All SYTP™

## BILL OF MATERIAL ENGLISH (METRIC)



**WARNING:** Use only Trinity Highway Products' parts on the ET-PLUS™ systems for installation, maintenance, or repair. The installation or co-mingling of unauthorized parts is strictly prohibited. Failure to follow this warning could result in 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"). The ET-PLUS™ systems and its component parts have been accepted for state use by FHWA. However, a co-mingled system has not been accepted.

### ET-PLUS™ SYSTEMS

(For specific materials and quantities, see state/specifying agency's option(s))

PN	Description
9G	12/12.5'/6' 3"/S (2.67/3.81/1.905/S) (Guardrail)
32G	12/12.5'/6' 3"/S (2.67/3.81/1.905/S) ANC (Guardrail)
60G	12/25'/6' 3"/S (2.67/7.62/1.905/S) (Guardrail)
62G	12/25'/6' 3"/S (2.67/7.62/1.905/S) ANC (Guardrail)
704A	Cable Anchor Bracket
705G	Pipe Sleeve - 2" STD Pipe x 5 <sup>1</sup> / <sub>2</sub> " (50 STD Pipe x 150 Pipe)
740G*	6" x 8" x 4' 6" x <sup>3</sup> / <sub>16</sub> " (152 x 203 x 1375 x 4.8) Tube Sleeve
749G	6" x 8" x 6' 0" x <sup>3</sup> / <sub>16</sub> " (152 x 203 x 1830 x 4.8) Tube Sleeve (Alternate to using 740G and 766G)
766G*	18" x 24" x <sup>1</sup> / <sub>4</sub> " (460 x 610 x 16) Soil Plate
782G	8" x 8" x <sup>5</sup> / <sub>8</sub> " (200 x 200 x 16) Bearing Plate
995A	ET-PLUS™ Extruder (Head)
3000G	Cable (Assembly) <sup>3</sup> / <sub>4</sub> " x 6' 6" (19 x 1981)
3300G	<sup>5</sup> / <sub>8</sub> " (16) Round Washer
3340G	<sup>5</sup> / <sub>8</sub> " (16) HGR Nut
3360G	<sup>5</sup> / <sub>8</sub> " DIA. X 1 <sup>1</sup> / <sub>4</sub> " (16 DIA. x 35) Splice Bolt (HGR)
3478G	<sup>5</sup> / <sub>8</sub> " DIA. x 7 <sup>1</sup> / <sub>2</sub> " (16 DIA. x 190) Hex Head Bolt
3497G	<sup>5</sup> / <sub>8</sub> " DIA. x 9 <sup>1</sup> / <sub>2</sub> " (16 DIA. x 240) Hex Head Bolt
3500G	<sup>5</sup> / <sub>8</sub> " DIA. x 10" (16 DIA. x 255) HGR Post Bolt
3580G	<sup>5</sup> / <sub>8</sub> " DIA. x 18" (16 DIA. x 460) HGR Post Bolt
3701G	<sup>3</sup> / <sub>4</sub> " (19) Washer
3704G	<sup>3</sup> / <sub>4</sub> " (19) HEX Nut
3717G	<sup>3</sup> / <sub>4</sub> " x 2 <sup>1</sup> / <sub>2</sub> " (19 x 75) Hex Head Bolt (High Strength)
3718G	<sup>3</sup> / <sub>4</sub> " x 3" (19 x 75) Hex Head Bolt (High Strength)
3900G	1" (25) Round Washer
3910G	1" (25) Hex Nut
4063B	Wood Post 6" x 8" x 6' 0" (150 x 200 x 1830) CRT
4075B	Wood Block 6" x 8" x 14" (150 x 200 x 360) DR
4076B	Wood Block - 6" x 8" x 14" (150 x 200 x 360) DR
4147B	Wood Post - 5 <sup>1</sup> / <sub>2</sub> " x 7 <sup>1</sup> / <sub>2</sub> " x 3' 9" (140 x 190 x 1145)
4254G	<sup>3</sup> / <sub>8</sub> " (10) Round Washer
4255G	<sup>3</sup> / <sub>8</sub> " (10) Fender Washer 1 <sup>1</sup> / <sub>2</sub> " OD (38)
4258G	<sup>3</sup> / <sub>8</sub> " (10) Lockwasher
4261G	<sup>3</sup> / <sub>8</sub> " DIA. X 1 <sup>1</sup> / <sub>2</sub> " (10 x 38) Hex Head Bolt
4228B	<sup>3</sup> / <sub>8</sub> " x 4" (10 x 100) Lag Screw
4388G	<sup>7</sup> / <sub>16</sub> " (11) Hex Nut
4389G	<sup>7</sup> / <sub>16</sub> " (11) Round Washer
4390G	<sup>7</sup> / <sub>16</sub> " DIA. x 1 <sup>1</sup> / <sub>2</sub> " (11 x 38) GR. 5 Hex Head Bolt
4393G	<sup>7</sup> / <sub>16</sub> " (11) Lockwasher
5148G	<sup>3</sup> / <sub>4</sub> " DIA. X 9 <sup>1</sup> / <sub>2</sub> " (19 DIA. x 240) Hex Head Bolt (High Strength)
4699G	<sup>3</sup> / <sub>4</sub> " (19) Lockwasher

PN	Description
6321G	$\frac{3}{8}$ " x 2' (10 x 50) Hex Head Bolt (High Strength)
6405G	$\frac{3}{8}$ " (10) Hex Nut
6907B	Polymer Block 4" x 7 $\frac{1}{2}$ " x 14" (100 x 187 x 350) [King Block]
14329G <sup>#</sup>	3' 6 $\frac{5}{8}$ " SYTP Stub
14578G <sup>#</sup>	6' Steel Yielding Terminal Post (SYTP)
33871A <sup>#</sup>	ET HBA Post #1 Top
33873A <sup>#</sup>	ET HBA Post #1 and #2 Bottom
33874A <sup>#</sup>	ET HBA Post #3 - #8 Bottom
33877A <sup>#</sup>	ET HBA Post #2 - #8 Top
9852A <sup>#</sup>	Strut (and Yoke Assembly)
33875G <sup>#</sup>	6' 6" (1980) Angle Strut ET HBA
33795G <sup>#</sup>	6' 6" (1980) Angle Strut
33730G <sup>#</sup>	6' 7 $\frac{1}{2}$ " (1980) Angle Strut
33847G <sup>#</sup>	6' 9 $\frac{1}{8}$ " Angle Strut

\* Option to the 6'0" Post Sleeve Tube

# Review the state/specifying agency's standard drawings of these systems, for details that are specific to the project or site locations.

### Delineation Options

PN	Description
6206B	Right Side 13" x 27 $\frac{1}{2}$ " (325 x 700) Reflective Sheeting
6207B	Left Side 13" x 27 $\frac{1}{2}$ " (325 x 700) Reflective Sheeting
6668B	Either Side 12" x 12" (305 x 305) Reflective Sheeting (Typically 2 required)

## INSTALLING THE ET-PLUS™ SYSTEMS

Use Trinity Highway Products' drawings for the ET-PLUS™ systems with these instructions. Review the state/specifying agency's standard drawings of this system. Details will be specific to the project or site locations.

	<b>WARNING:</b> Use only Trinity Highway Products' parts on the ET-PLUS™ systems for installation, maintenance, or repair. The installation or co-mingling of unauthorized parts is strictly prohibited. Failure to follow this warning could result in 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"). The ET-PLUS™ systems and its component parts have been accepted for state use by FHWA. However, a co-mingled system has not been accepted.
	<b>WARNING:</b> Ensure that there is proper site grading for tube and post placement, as dictated by the state/specifying agency, pursuant to FHWA acceptance. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Do NOT install 6'0" CRT post at location 1. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Do NOT install SYTP™ at location 1. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Ensure that all Guardrail products and delineation used meet all federal, state/specifying agency, and local specifications. Failure to follow this warning could result in serious injury or death in the event of a collision.

### MATERIALS

As packaged, the ET-PLUS™ systems include all materials needed for a complete installation. This will include either a 50' (15.24 m) system, 37' 6" (11.43 m) system, or 25' (7.62 m) system pay limit, unless otherwise specified in the contract plans. Note that concrete footings or foundations are not required.

### TOOLS REQUIRED

The following list shows recommended tools for installation of the ET-PLUS™ systems:

- $\frac{9}{16}$ " (14 mm) Socket or Wrench
- $\frac{15}{16}$ " (24 mm) Socket or Wrench
- $1\frac{1}{4}$ " (32 mm) Socket or Wrench
- $1\frac{1}{2}$ " (38 mm) Socket or Wrench
- Augers
- Post Pounders (commonly used in driving posts)
- Locking Pliers
- Tape Measure

The following list shows recommended tools for the repair of the ET-PLUS™ systems. However, since repair is directed by the state/specifying agency, they may have more specific guidelines.

- Acetylene torch to cut off extruded rail
- Heavy-duty chain to remove the ET-PLUS™ Extruder (Head)
- Locking Pliers or channel lock pliers
- Sledge hammer
- Post removal tool and other normal guardrail tools
- Eye bolts connected to heavy duty chain (to remove the posts from tubes)
- Vehicle to pull the Extruder from the damaged rail

## SITE PREPARATION

When the Guardrail is installed in-line with edge of the shoulder (without any offset), a 25:1 or flatter straight flare over the length of the systems can be used to position the ET-PLUS™ Extruder (Head) further away from the edge of the shoulder. Minor site grading may be necessary for installations beyond the edge of the shoulder, for the proper placement of the steel tubes and the CRT posts. Use the state/specifying agency's standard specifications and drawings for the site grading. Trinity does not direct grading. Complete all grading before the start of the installation of the ET-PLUS™ systems. See INSTALLATION OF THE ET-PLUS™ SYSTEMS ON A CURVE section for the layout of the ET-PLUS™ systems on a curve.



**WARNING:** Ensure that there is proper site grading for tube and post placement, as dictated by the state/specifying agency, pursuant to FHWA acceptance. Failure to follow this warning could result in serious injury or death in the event of a collision.

## INSTALLATION



**WARNING:** Ensure that this installation conforms with the guidance provided by the AASHTO Roadside Design Guide, including, but not limited to, those regarding placement on curbs. Failure to follow this warning could result in serious injury or death in the event of a collision.

For installation of the ET-PLUS™ systems, see POST INSTALLATION section. If the systems are installed on a curve, see INSTALLATION OF THE ET-PLUS™ SYSTEMS ON A CURVE. When installing the ET-PLUS™ systems outside or inside the curve, the ET must be straight over the length of the systems. If there are special field conditions encountered when installing the ET-PLUS™ systems, contact the state/specifying agency's engineer. Trinity Highway Products LLC., at 1-800-644-7976, is available to assist the state/specifying agency, if needed.

## POST INSTALLED IN RIGID MATERIAL

Provide the proper leave out (specified area of open space in the pavement) around a post when installing the post in any thickness of concrete or asphalt. **The top surfaces of any grout or other backfill placed in the rigid material "leave out" MUST be low enough so that it does not engage the anchor cable bearing plate at Post 1 or otherwise obstruct/constrain the 3/8" shear bolts or the 3/4" hinge bolts of the HBA Post.**

For "leave-out" information, please consult the applicable state/specifying agency. Additional source of "leave-out" information/details can be found in the U.S. Department of Transportation, Federal Highway Administration, Memorandum B64-B, dated 3-10-04. Trinity can provide this FHWA memo upon request.



**WARNING:** Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt.

## INSTALLATION OF THE ET-PLUS™ SYSTEMS ON A CURVE

When the ET-PLUS™ systems are installed on a curve, use the following layouts. All offsets are measured to the face of the rail. Under no circumstances shall the guardrail within the ET-PLUS™ pay limit be curved.

- **Outside the curve:** With the line guardrail installed parallel to the curve, the terminal end is offset from the curve a distance equal to the line guardrail offset plus the value in Table 1. (See state/specifying agency drawings for details.)
- **Inside the curve (radius Greater than 1000 feet):** With the line guardrail installed parallel to the curve, the terminal end is offset from the curve a distance equal to the line guardrail offset plus the value in Table 1. (See state/specifying agency drawings for details.)
- **Inside the curve (radius 1000 feet or Less):** With the line guardrail installed parallel to the curve, the terminal end is offset from the

curve a distance equal to the line guardrail offset plus 1 foot maximum in Table 1. (See state/specifying agency drawings for details.)

ET™ Length	Outside the Curve Max Offset	Inside the Curve With a Radius Greater Than 1000 Feet Max Offset	Inside the Curve With a Radius 1000 Feet or Less Max Offset
50 Feet	2 Feet	2 Feet	1 Foot
37 Feet 6 Inches	1.5 Feet	1.5 Feet	1 Foot
25 Feet	1 Foot	1 Foot	1 Foot

Table 1

## POST INSTALLATION

Complete the following steps when installing wood CRT posts, foundation tubes with wood posts, HBA™ posts, and SYTP™. When installing posts in rigid pavement, see the POST INSTALLED IN RIGID MATERIAL section.

	<b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.
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## INSTALLING THE WOOD CRT POSTS

Complete the following steps to install the wood CRT posts:

Step	Actions								
1.	<p>Install the wood posts (PN-4063B) at locations required for the systems, spaced at 6' 3" (1270 mm) apart. Select Option A or Option B to install the CRT posts.</p> <table border="1" style="width: 100%;"> <tr> <td style="width: 15%;"><b>Option A</b></td> <td>Drive posts into the ground.</td> </tr> <tr> <td><b>Option B</b></td> <td> <ol style="list-style-type: none"> <li>1. Drill 12" (300 mm) maximum diameter pilot holes approximately 44" (1120 mm) deep.</li> <li>2. Insert the 6' 0" (1830 mm) wood posts into these holes.</li> <li>3. Backfill the holes with compactable materials in 6" (150 mm) lifts and compact with pneumatic equipment to optimum compaction.</li> </ol> </td> </tr> </table> <p><b>Note:</b> In either option within Step 1, the bottom of the upper 3½" (90 mm) hole in the post is approximately at the finished grade.</p> <table border="1" style="width: 100%;"> <tr> <td style="text-align: center;"></td> <td><b>WARNING:</b> Do NOT install 6'0" CRT post at location 1. Failure to follow this warning could result in serious injury or death in the event of a collision.</td> </tr> <tr> <td style="text-align: center;"></td> <td><b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.</td> </tr> </table>	<b>Option A</b>	Drive posts into the ground.	<b>Option B</b>	<ol style="list-style-type: none"> <li>1. Drill 12" (300 mm) maximum diameter pilot holes approximately 44" (1120 mm) deep.</li> <li>2. Insert the 6' 0" (1830 mm) wood posts into these holes.</li> <li>3. Backfill the holes with compactable materials in 6" (150 mm) lifts and compact with pneumatic equipment to optimum compaction.</li> </ol>		<b>WARNING:</b> Do NOT install 6'0" CRT post at location 1. Failure to follow this warning could result in serious injury or death in the event of a collision.		<b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.
<b>Option A</b>	Drive posts into the ground.								
<b>Option B</b>	<ol style="list-style-type: none"> <li>1. Drill 12" (300 mm) maximum diameter pilot holes approximately 44" (1120 mm) deep.</li> <li>2. Insert the 6' 0" (1830 mm) wood posts into these holes.</li> <li>3. Backfill the holes with compactable materials in 6" (150 mm) lifts and compact with pneumatic equipment to optimum compaction.</li> </ol>								
	<b>WARNING:</b> Do NOT install 6'0" CRT post at location 1. Failure to follow this warning could result in serious injury or death in the event of a collision.								
	<b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.								

## PLACING FOUNDATION TUBES FOR WOOD OR SYT™ POSTS

Complete the following steps to install foundation tubes and Wood or SYT™ posts:

Step	Actions						
1.	<p>Select Option A or Option B for this tube installation.</p> <table border="1"> <tr> <td><b>Option A</b></td> <td> <p><b>1. For 6' 0" (1830 mm) Tube without Soil Plate</b></p> <ol style="list-style-type: none"> <li>1. Install the foundation tube (PN-749G), per Step 2 below.</li> </ol> <p><b>2. For 4' 6" (1375 mm) Tube without Soil Plate (locations 3 through 8, locations 3 through 7, or locations 3 through 4)</b></p> <ol style="list-style-type: none"> <li>1. Install the soil tube (PN-740G), per Step 2 below.</li> </ol> </td> </tr> <tr> <td><b>Option B</b></td> <td> <p><b>1. For 4' 6" (1375 mm) Tube with Soil Plate (locations 1 &amp; 2)</b></p> <ol style="list-style-type: none"> <li>1. Assemble the soil tubes and soil plates.</li> <li>2. Bolt the soil plate (PN-766G) to the foundation tube (PN-740G) with two <math>\frac{5}{8}</math>" x <math>7\frac{1}{2}</math>" (16 mm x 190 mm) Hex Head Bolts (PN-3478G) and <math>\frac{5}{8}</math>" (16 mm) HGR Nuts (PN-3340G) (no washers).</li> <li>3. Install the foundation tube (PN-766G) with soil plate, per Step 2 below.</li> </ol> <p><b>2. For 4' 6" (1375 mm) Tube without Soil Plate (locations 3 through 8, locations 3 through 7, or locations 3 through 4)</b></p> <ol style="list-style-type: none"> <li>1. Install the soil tube (PN-740G), per Step 2 below.</li> </ol> </td> </tr> </table> <p><b>Note:</b> Do not over tighten the nuts and deform the tubes, this will complicate post replacement.</p> <table border="1"> <tr> <td style="text-align: center;">  </td> <td> <p><b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.</p> </td> </tr> </table>	<b>Option A</b>	<p><b>1. For 6' 0" (1830 mm) Tube without Soil Plate</b></p> <ol style="list-style-type: none"> <li>1. Install the foundation tube (PN-749G), per Step 2 below.</li> </ol> <p><b>2. For 4' 6" (1375 mm) Tube without Soil Plate (locations 3 through 8, locations 3 through 7, or locations 3 through 4)</b></p> <ol style="list-style-type: none"> <li>1. Install the soil tube (PN-740G), per Step 2 below.</li> </ol>	<b>Option B</b>	<p><b>1. For 4' 6" (1375 mm) Tube with Soil Plate (locations 1 &amp; 2)</b></p> <ol style="list-style-type: none"> <li>1. Assemble the soil tubes and soil plates.</li> <li>2. Bolt the soil plate (PN-766G) to the foundation tube (PN-740G) with two <math>\frac{5}{8}</math>" x <math>7\frac{1}{2}</math>" (16 mm x 190 mm) Hex Head Bolts (PN-3478G) and <math>\frac{5}{8}</math>" (16 mm) HGR Nuts (PN-3340G) (no washers).</li> <li>3. Install the foundation tube (PN-766G) with soil plate, per Step 2 below.</li> </ol> <p><b>2. For 4' 6" (1375 mm) Tube without Soil Plate (locations 3 through 8, locations 3 through 7, or locations 3 through 4)</b></p> <ol style="list-style-type: none"> <li>1. Install the soil tube (PN-740G), per Step 2 below.</li> </ol>		<p><b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.</p>
<b>Option A</b>	<p><b>1. For 6' 0" (1830 mm) Tube without Soil Plate</b></p> <ol style="list-style-type: none"> <li>1. Install the foundation tube (PN-749G), per Step 2 below.</li> </ol> <p><b>2. For 4' 6" (1375 mm) Tube without Soil Plate (locations 3 through 8, locations 3 through 7, or locations 3 through 4)</b></p> <ol style="list-style-type: none"> <li>1. Install the soil tube (PN-740G), per Step 2 below.</li> </ol>						
<b>Option B</b>	<p><b>1. For 4' 6" (1375 mm) Tube with Soil Plate (locations 1 &amp; 2)</b></p> <ol style="list-style-type: none"> <li>1. Assemble the soil tubes and soil plates.</li> <li>2. Bolt the soil plate (PN-766G) to the foundation tube (PN-740G) with two <math>\frac{5}{8}</math>" x <math>7\frac{1}{2}</math>" (16 mm x 190 mm) Hex Head Bolts (PN-3478G) and <math>\frac{5}{8}</math>" (16 mm) HGR Nuts (PN-3340G) (no washers).</li> <li>3. Install the foundation tube (PN-766G) with soil plate, per Step 2 below.</li> </ol> <p><b>2. For 4' 6" (1375 mm) Tube without Soil Plate (locations 3 through 8, locations 3 through 7, or locations 3 through 4)</b></p> <ol style="list-style-type: none"> <li>1. Install the soil tube (PN-740G), per Step 2 below.</li> </ol>						
	<p><b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.</p>						
2.	<p>Install the foundation tubes at <b>locations 1 and 2</b>. Use the strut as a guide for the spacing of the tubes. If the soil plate is utilized, position it on the downstream side of the post (away from the impact head).</p> <p><b>Note:</b> Do not drive tubes with the wood post inserted, this will complicate post replacement.</p>						

## INSTALLATION OPTIONS FOR FOUNDATION TUBES FOR WOOD OR SYT™ POSTS

Complete the following steps to install foundation tubes and Wood or SYT™ posts:

### FOR PERMEABLE SOIL

Step	Actions
1.	<p>If the soil is permeable (water will drain from the tubes), drive the tubes (with an appropriate driving head) to the optimum height, where the top of the tube is <math>2\frac{5}{8}</math>" (67 mm) above the finished grade.</p> <p><b>Note:</b> Take extra care to prevent settlement or lateral displacement of the tubes, to ensure the posts attach to the Guardrail, correctly.</p>
2.	<p>Ensure that the finished Guardrail height will be approximately <math>27\frac{3}{4}</math>" (706 mm) above the finished grade, or as the state/specifying agency plans indicate.</p>
3.	<p>Ensure that the tubes do not project more than 4" (100 mm) above the finished grade.</p>



**WARNING:** Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.

## FOR NON-PERMEABLE SOIL

Step	Actions												
1.	<p>Select Option A, Option B, or Option C below, if soil is non-permeable.</p> <table border="1" data-bbox="184 471 940 1406"> <tr> <td data-bbox="184 471 291 656"> <p><b>Option A</b></p> </td> <td data-bbox="291 471 940 656"> <p><b>For 6' Tube Only</b></p> <ol style="list-style-type: none"> <li>1. Drill a 12" (300 mm) maximum diameter pilot hole approximately 75" (1905 mm) deep.</li> <li>2. Insert the tube into the hole to the optimum depth, where the top of the tube is 2<sup>5</sup>/<sub>8</sub>" (67 mm) above the finished grade.</li> </ol> </td> </tr> <tr> <td data-bbox="184 656 291 923"></td> <td data-bbox="291 656 940 923"> <p><b>For 4' 6" Tube with Soil Plate</b></p> <ol style="list-style-type: none"> <li>1. Drill a 12" (300 mm) maximum diameter pilot hole approximately 57" (1450 mm) deep.</li> <li>2. Insert the soil plate/tube assembly into the hole by impact or vibratory means with an appropriate driving head.</li> <li>3. Insert the tube to the optimum depth of where the top of the tube is 2<sup>5</sup>/<sub>8</sub>" (67 mm) of the above the finished grade.</li> </ol> </td> </tr> <tr> <td data-bbox="184 923 291 1109"></td> <td data-bbox="291 923 940 1109"> <p><b>For 4' 6" Tube without Soil Plate</b></p> <ol style="list-style-type: none"> <li>1. Drill a 12" (300 mm) maximum diameter pilot hole approximately 57" (1450 mm) deep.</li> <li>2. Insert the tube into the hole to the optimum depth, where the top of the tube is 2<sup>5</sup>/<sub>8</sub>" (67 mm) above the finished grade.</li> </ol> </td> </tr> <tr> <td data-bbox="184 1109 291 1223"> <p><b>Option B</b></p> </td> <td data-bbox="291 1109 940 1223"> <p><b>For 4' 6" Tube with Soil Plate</b></p> <p>Cut slots for the soil plates out by hand or by using a rock bar and then follow all of the steps of Option A for 4' 6" tube with soil plate, above.</p> </td> </tr> <tr> <td data-bbox="184 1223 291 1406"> <p><b>Option C</b></p> </td> <td data-bbox="291 1223 940 1406"> <p><b>For 4' 6" Tube with Soil Plate</b></p> <p>Drill three adjacent 12" (300 mm) maximum diameter holes or one 24" (610 mm) maximum diameter hole to accommodate the soil plate/tube assembly and then follow all of the steps of Option A for 4' 6" tube with soil plate, above.</p> </td> </tr> </table> <p><b>Note:</b> Take extra care to prevent settlement or lateral displacement of the tubes, to ensure the posts attach to the Guardrail, correctly.</p> <table border="1" data-bbox="184 1530 940 1763"> <tr> <td data-bbox="184 1530 291 1763">  </td> <td data-bbox="291 1530 940 1763"> <p><b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.</p> </td> </tr> </table>	<p><b>Option A</b></p>	<p><b>For 6' Tube Only</b></p> <ol style="list-style-type: none"> <li>1. Drill a 12" (300 mm) maximum diameter pilot hole approximately 75" (1905 mm) deep.</li> <li>2. Insert the tube into the hole to the optimum depth, where the top of the tube is 2<sup>5</sup>/<sub>8</sub>" (67 mm) above the finished grade.</li> </ol>		<p><b>For 4' 6" Tube with Soil Plate</b></p> <ol style="list-style-type: none"> <li>1. Drill a 12" (300 mm) maximum diameter pilot hole approximately 57" (1450 mm) deep.</li> <li>2. Insert the soil plate/tube assembly into the hole by impact or vibratory means with an appropriate driving head.</li> <li>3. Insert the tube to the optimum depth of where the top of the tube is 2<sup>5</sup>/<sub>8</sub>" (67 mm) of the above the finished grade.</li> </ol>		<p><b>For 4' 6" Tube without Soil Plate</b></p> <ol style="list-style-type: none"> <li>1. Drill a 12" (300 mm) maximum diameter pilot hole approximately 57" (1450 mm) deep.</li> <li>2. Insert the tube into the hole to the optimum depth, where the top of the tube is 2<sup>5</sup>/<sub>8</sub>" (67 mm) above the finished grade.</li> </ol>	<p><b>Option B</b></p>	<p><b>For 4' 6" Tube with Soil Plate</b></p> <p>Cut slots for the soil plates out by hand or by using a rock bar and then follow all of the steps of Option A for 4' 6" tube with soil plate, above.</p>	<p><b>Option C</b></p>	<p><b>For 4' 6" Tube with Soil Plate</b></p> <p>Drill three adjacent 12" (300 mm) maximum diameter holes or one 24" (610 mm) maximum diameter hole to accommodate the soil plate/tube assembly and then follow all of the steps of Option A for 4' 6" tube with soil plate, above.</p>		<p><b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.</p>
<p><b>Option A</b></p>	<p><b>For 6' Tube Only</b></p> <ol style="list-style-type: none"> <li>1. Drill a 12" (300 mm) maximum diameter pilot hole approximately 75" (1905 mm) deep.</li> <li>2. Insert the tube into the hole to the optimum depth, where the top of the tube is 2<sup>5</sup>/<sub>8</sub>" (67 mm) above the finished grade.</li> </ol>												
	<p><b>For 4' 6" Tube with Soil Plate</b></p> <ol style="list-style-type: none"> <li>1. Drill a 12" (300 mm) maximum diameter pilot hole approximately 57" (1450 mm) deep.</li> <li>2. Insert the soil plate/tube assembly into the hole by impact or vibratory means with an appropriate driving head.</li> <li>3. Insert the tube to the optimum depth of where the top of the tube is 2<sup>5</sup>/<sub>8</sub>" (67 mm) of the above the finished grade.</li> </ol>												
	<p><b>For 4' 6" Tube without Soil Plate</b></p> <ol style="list-style-type: none"> <li>1. Drill a 12" (300 mm) maximum diameter pilot hole approximately 57" (1450 mm) deep.</li> <li>2. Insert the tube into the hole to the optimum depth, where the top of the tube is 2<sup>5</sup>/<sub>8</sub>" (67 mm) above the finished grade.</li> </ol>												
<p><b>Option B</b></p>	<p><b>For 4' 6" Tube with Soil Plate</b></p> <p>Cut slots for the soil plates out by hand or by using a rock bar and then follow all of the steps of Option A for 4' 6" tube with soil plate, above.</p>												
<p><b>Option C</b></p>	<p><b>For 4' 6" Tube with Soil Plate</b></p> <p>Drill three adjacent 12" (300 mm) maximum diameter holes or one 24" (610 mm) maximum diameter hole to accommodate the soil plate/tube assembly and then follow all of the steps of Option A for 4' 6" tube with soil plate, above.</p>												
	<p><b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.</p>												
2.	Backfill the hole with compactable materials in 6" (150 mm) lifts and compact with pneumatic equipment to optimum compaction.												
3.	Ensure that the finished Guardrail height will be approximately 27 <sup>3</sup> / <sub>4</sub> " (706 mm) above the finished grade, or as the state/specifying agency plans indicate.												
4.	Ensure that the tubes do not project more than 4" (100 mm) above the finished grade.												

## INSTALLING HBA™ BOTTOM POSTS

Complete the following steps to install HBA™ Bottom Posts:

Step	Actions						
1.	Arrange the posts so that the large hole ( $1\frac{3}{16}$ " [21 mm]) is placed downstream (away from the impact end of the systems).						
2.	Adjust the offset to <b>Post 2</b> , if the ET-PLUS™ Extruder (Head) causes a gap between the rail panel and <b>Post 2</b> . <b>Note:</b> The rail panel must be within $\frac{1}{2}$ " (13 mm) of <b>Post 2</b> .						
3.	Select Option A or Option B for this installation. <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%; text-align: center;"><b>Option A</b></td> <td>1. Drive the HBA™ Bottom Posts (PN-33873A, PN-33874A) with an approved driving head to the appropriate depths. The appropriate depth will be approximately 72" (1830 mm) for post PN-33873A, at <b>Posts 1 and 2</b> and 44" (1120 mm) for post PN-33874A, at <b>Posts 3 through 8, Posts 3 through 7, or Posts 3 through 4</b>.</td> </tr> <tr> <td style="text-align: center;"><b>Option B</b></td> <td> <p><b>For HBA™ Bottom Posts (PN-33873A) at Posts 1 and 2</b></p> <p>1. Drill a 12" (300 mm) maximum diameter pilot hole approximately 72" (1830 mm) deep.</p> <p><b>For HBA™ Bottom Posts (PN-33874A) at Posts 3 through 8, Posts 3 through 7, or Posts 3 through 4</b></p> <p>1. Drill a 12" (300 mm) maximum diameter pilot hole approximately 44" (1120 mm) deep.</p> <p>2. Insert the posts to the appropriate depth by impact or vibratory means with an appropriate driving head.</p> <p>3. Backfill the hole with compactable materials in 6" (150 mm) lifts and compact with pneumatic equipment to optimum compaction.</p> </td> </tr> </table> <p><b>Note:</b> In either option, the optimum depth will have the <math>1\frac{3}{16}</math>" (21 mm) hole in the post plates (ears) even with the finished grade.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%; text-align: center;"></td> <td><b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.</td> </tr> </table>	<b>Option A</b>	1. Drive the HBA™ Bottom Posts (PN-33873A, PN-33874A) with an approved driving head to the appropriate depths. The appropriate depth will be approximately 72" (1830 mm) for post PN-33873A, at <b>Posts 1 and 2</b> and 44" (1120 mm) for post PN-33874A, at <b>Posts 3 through 8, Posts 3 through 7, or Posts 3 through 4</b> .	<b>Option B</b>	<p><b>For HBA™ Bottom Posts (PN-33873A) at Posts 1 and 2</b></p> <p>1. Drill a 12" (300 mm) maximum diameter pilot hole approximately 72" (1830 mm) deep.</p> <p><b>For HBA™ Bottom Posts (PN-33874A) at Posts 3 through 8, Posts 3 through 7, or Posts 3 through 4</b></p> <p>1. Drill a 12" (300 mm) maximum diameter pilot hole approximately 44" (1120 mm) deep.</p> <p>2. Insert the posts to the appropriate depth by impact or vibratory means with an appropriate driving head.</p> <p>3. Backfill the hole with compactable materials in 6" (150 mm) lifts and compact with pneumatic equipment to optimum compaction.</p>		<b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.
<b>Option A</b>	1. Drive the HBA™ Bottom Posts (PN-33873A, PN-33874A) with an approved driving head to the appropriate depths. The appropriate depth will be approximately 72" (1830 mm) for post PN-33873A, at <b>Posts 1 and 2</b> and 44" (1120 mm) for post PN-33874A, at <b>Posts 3 through 8, Posts 3 through 7, or Posts 3 through 4</b> .						
<b>Option B</b>	<p><b>For HBA™ Bottom Posts (PN-33873A) at Posts 1 and 2</b></p> <p>1. Drill a 12" (300 mm) maximum diameter pilot hole approximately 72" (1830 mm) deep.</p> <p><b>For HBA™ Bottom Posts (PN-33874A) at Posts 3 through 8, Posts 3 through 7, or Posts 3 through 4</b></p> <p>1. Drill a 12" (300 mm) maximum diameter pilot hole approximately 44" (1120 mm) deep.</p> <p>2. Insert the posts to the appropriate depth by impact or vibratory means with an appropriate driving head.</p> <p>3. Backfill the hole with compactable materials in 6" (150 mm) lifts and compact with pneumatic equipment to optimum compaction.</p>						
	<b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.						

## INSTALLING FOUNDATION TUBES, HBA™ POSTS, OR SYTP™ WHEN ENCOUNTERING ROCK

Complete the following steps to install foundation tubes, HBA™ posts or SYTP™ when encountering rock:

Step	Actions		
1.	Select Option A or Option B below when encountering rock, unless there is a more restrictive state/specifying agency specification. <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%; text-align: center;"><b>Option A</b></td> <td> <p><b>If rock is encountered with depth of 20" (510 mm) or less</b></p> <p>1. Drill a 12" - 16" (300 mm - 400 mm) diameter hole into the rock.</p> <p>2. Drill the hole 2" (50 mm) deeper than the required embedment depth.</p> <p>3. Place granular material or small pieces of the drilled rock in the bottom 2" (50 mm) of the hole for drainage.</p> <p>Continues on next page.</p> </td> </tr> </table>	<b>Option A</b>	<p><b>If rock is encountered with depth of 20" (510 mm) or less</b></p> <p>1. Drill a 12" - 16" (300 mm - 400 mm) diameter hole into the rock.</p> <p>2. Drill the hole 2" (50 mm) deeper than the required embedment depth.</p> <p>3. Place granular material or small pieces of the drilled rock in the bottom 2" (50 mm) of the hole for drainage.</p> <p>Continues on next page.</p>
<b>Option A</b>	<p><b>If rock is encountered with depth of 20" (510 mm) or less</b></p> <p>1. Drill a 12" - 16" (300 mm - 400 mm) diameter hole into the rock.</p> <p>2. Drill the hole 2" (50 mm) deeper than the required embedment depth.</p> <p>3. Place granular material or small pieces of the drilled rock in the bottom 2" (50 mm) of the hole for drainage.</p> <p>Continues on next page.</p>		

	<p>4. Install the tube/post into the hole. Backfill the hole with compactable materials in 6" (150 mm) lifts and compact with pneumatic equipment to optimum compaction.</p> <p><b>Note:</b> If compactable, the material removed from the hole may be used for the backfill.</p>
<b>Option B</b>	<p><b>If rock is encountered with depth greater than 20" (510 mm)</b></p> <ol style="list-style-type: none"> <li>1. Drill a 12" - 16" (300 mm - 400 mm) diameter hole 22" (560 mm) deep into the rock.</li> <li>2. Cut off the embedded portion of the tube/post so the Guardrail will be installed at the proper mounting height.</li> <li>3. Place granular material or small pieces of the drilled rock in the bottom 2" (50 mm) of the hole for drainage.</li> <li>4. Install the tube/post in the hole. Backfill the hole with compactable materials in 6" (150 mm) lifts and compact with pneumatic equipment to optimum compaction.</li> </ol> <p><b>Note:</b> If compactable, the material removed from the hole may be used for the backfill.</p>
	<p><b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.</p>

## INSTALLING WOOD POSTS IN TUBES

Complete the following steps to install wood posts in tubes:

Step	Actions
1.	Insert Pipe Sleeve (PN-705G) in post (PN-4147B) and install the wood post in the steel tube at <b>location 1</b> .
2.	Install wood post(s) (PN-4147B) in tubes at locations required for the systems, as dictated by the state/specifying agency.
3.	Insert a $\frac{5}{8}$ " x $9\frac{1}{2}$ " (16 mm x 240 mm) Hex Head Bolt (PN-3497G) through the foundation tube and the wood post at all <b>locations EXCEPT locations 1 and 2</b> .
	<b>Note:</b> The bolt must be installed from the embankment side, to aid in possible post replacement.
4.	Place a $\frac{5}{8}$ " (16 mm) HGR Nut (PN-3340G) on the end of the inserted bolt.
5.	Tighten the nuts to a snug position.
	<b>Note:</b> Do not over tighten the bolts and deform the tubes, this will complicate post replacement.

	<p><b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.</p>
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## INSTALLING HBA™ TOP POSTS

Complete the following steps to install the HBA™ Top Posts, after the Bottom Posts have been installed:

### AT POST 1

Step	Actions
1.	Install the Top Post (PN-33871A) at <b>Post 1</b> , by aligning the holes of the post plates (ears) on the Top and Bottom Posts.
	<b>Note:</b> The Top Post's post plates (ears) can be installed on either side of the Bottom Post's post plates (ears).
2.	Insert a $\frac{3}{8}$ " (10 mm) diameter x 2" (50 mm) Hex Head High Strength Bolt (PN-6321G) through the $\frac{7}{16}$ " (11 mm) holes of the

	post plates (ears) on the Top and Bottom Posts.
3.	Place a $\frac{3}{8}$ " (10 mm) Washer (PN-4252G) and a $\frac{3}{8}$ " (10 mm) Lockwasher (PN-4258G) under a $\frac{3}{8}$ " (10 mm) Hex Nut (PN-6405G) on the inserted bolts to secure. <b>Note:</b> The bolts can be installed so the nuts are on the inside or outside of the post plates (ears).
4.	Tighten the nuts to a snug position. The designer does not recommend a torque requirement for the HBA field assembly.
5.	Insert a $\frac{3}{4}$ " (19 mm) diameter x $2\frac{1}{2}$ " (63 mm) Hex Head High Strength Bolt (PN-5148G) in the $\frac{13}{16}$ " (21 mm) hole of the HBA™ <b>Post 1</b> post plates on the side opposite the strut. Do not install the $\frac{3}{4}$ " (19 mm) bolt on the strut side of <b>Post 1</b> , until the strut is ready to be installed. <b>Note:</b> The bolts can be installed so the nuts are on the inside or outside of the post plates (ears).
6.	Place a $\frac{3}{4}$ " (19 mm) Washer (PN-3701G) and a $\frac{3}{4}$ " (19 mm) Lockwasher (PN-4699G) under a $\frac{3}{4}$ " (19 mm) Hex Nut on the inserted bolt to secure.
7.	Tighten the nuts to a snug position. The designer does not recommend a torque requirement for the HBA field assembly.

## AT POST 2

Step	Actions
1.	Install the Top Post (PN-33877A) at <b>Post 2</b> , by aligning the holes of the post plates (ears) on the Top and Bottom Posts.
2.	Insert a $\frac{3}{8}$ " (10 mm) diameter x 2" (50 mm) Hex Head High Strength Bolt (PN-6321G) in the $\frac{7}{16}$ " (11 mm) holes. <b>Note:</b> For the bolt opposite the strut, install it so the nut is on either side of the post plates (ears). For the $\frac{3}{8}$ " (10 mm) bolt that is on the side of the strut, install the bolt through the post plates (ears) with the bolt head on the same side as the strut.
3.	Place a $\frac{3}{8}$ " (10 mm) Washer (PN-4251G) and a $\frac{3}{8}$ " (10 mm) Lockwasher (PN-4258G) under a $\frac{3}{8}$ " (10 mm) Hex Nut (PN-6405G) on the inserted bolts to secure.
4.	Tighten the nuts to a snug position. The designer does not recommend a torque requirement for the HBA field assembly.
5.	Insert a $\frac{3}{4}$ " (19 mm) diameter x $2\frac{1}{2}$ " (63 mm) Hex Head High Strength Bolt (PN-5148G) through the $\frac{13}{16}$ " (21 mm) hole of the HBA™ <b>Post 2</b> post plates on the side opposite the strut. Do not install the $\frac{3}{4}$ " (19 mm) bolt on the strut side of <b>Post 2</b> , until the strut is ready to be installed. <b>Note:</b> The bolts can be installed so the nuts are on the inside or outside of the post plates (ears).
6.	Place a $\frac{3}{4}$ " (19 mm) Washer (PN-3701G) and a $\frac{3}{4}$ " (19 mm) Lockwasher (PN-4699G) under a $\frac{3}{4}$ " (19 mm) Hex Nut on the inserted bolt to secure.
7.	Tighten the nuts to a snug position. The designer does not recommend a torque requirement for the HBA field assembly.

## AT POSTS 3 THROUGH 8, POSTS 3 THROUGH 7, OR POSTS 3 AND 4

Step	Actions
1.	Arrange the Top Posts (PN-33877A), for <b>Posts 3 through 8</b> , <b>Posts 3 through 7</b> , or for <b>Posts 3 through 4</b> , by aligning the holes of the post plates (ears) on the HBA™ Top and Bottom Posts, if used.
2.	Insert a $\frac{3}{8}$ " (10 mm) diameter x 2" (50 mm) Hex Head Bolt (PN-6321G) through in the $\frac{7}{16}$ " (11 mm) holes of the post plates (ears).
3.	Place a $\frac{3}{8}$ " (10 mm) washer (PN-4254G) and a $\frac{3}{8}$ " (10 mm) Lockwasher (PN-4258G) under a $\frac{3}{8}$ " (10 mm) Hex Nut (PN-6405G) on the inserted $\frac{3}{8}$ " diameter Hex Head Bolt.
4.	Insert a $\frac{3}{4}$ " (19 mm) diameter x $2\frac{1}{2}$ " (63 mm) Hex Head High Strength Bolt (PN-6321G) through the $\frac{13}{16}$ " (21 mm) holes. <b>Note:</b> The bolts can be installed so the nuts are on either side of the post plates (ears).

5.	Place a $\frac{3}{4}$ " (19 mm) Washer (PN-4252G) and a $\frac{3}{4}$ " (19 mm) Lockwasher (PN-4258G) under $\frac{3}{4}$ " (19 mm) Hex Nut on the inserted $\frac{3}{4}$ " (19 mm) diameter Hex Head High Strength Bolt to secure.
6.	Tighten the nuts to a snug position. The designer does not recommend a torque requirement for the HBA field assembly.

### INSTALLING THE SYTP™

The SYTP™ can be driven or installed in a tube. For SYTP™ installation in a tube, see the INSTALLING THE SYTP™ IN TUBES section. The SYTP™ can be installed at all locations **EXCEPT** at **location 1**.

Complete the following step to install the SYTP™:

	<b>WARNING:</b> Do NOT install SYTP™ at <b>location 1</b> . Failure to follow this warning could result in serious injury or death in the event of a collision.
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### DRIVING THE 6' SYTP™

Step	Actions				
1.	Drive all the 6'0" SYTP™ (PN-14578) to the optimum depth, where the centers of the four (4) yielding holes through the flange are at the ground line. <table border="1" style="margin-top: 10px;"> <tr> <td style="text-align: center;"></td> <td><b>WARNING:</b> Do NOT install SYTP™ at <b>location 1</b>. Failure to follow this warning could result in serious injury or death in the event of a collision.</td> </tr> <tr> <td style="text-align: center;"></td> <td><b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.</td> </tr> </table>		<b>WARNING:</b> Do NOT install SYTP™ at <b>location 1</b> . Failure to follow this warning could result in serious injury or death in the event of a collision.		<b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Do NOT install SYTP™ at <b>location 1</b> . Failure to follow this warning could result in serious injury or death in the event of a collision.				
	<b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.				

### INSTALLING THE SYTP™ IN TUBES

Step	Actions				
1.	Install the 3' 6 $\frac{5}{8}$ " SYTP(s)™ (PN-14329) in tubes, as dictated by the state/specifying agency. <table border="1" style="margin-top: 10px;"> <tr> <td style="text-align: center;"></td> <td><b>WARNING:</b> Do NOT install SYTP™ at <b>location 1</b>. Failure to follow this warning could result in serious injury or death in the event of a collision.</td> </tr> <tr> <td style="text-align: center;"></td> <td><b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.</td> </tr> </table>		<b>WARNING:</b> Do NOT install SYTP™ at <b>location 1</b> . Failure to follow this warning could result in serious injury or death in the event of a collision.		<b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Do NOT install SYTP™ at <b>location 1</b> . Failure to follow this warning could result in serious injury or death in the event of a collision.				
	<b>WARNING:</b> Ensure that the proper Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt. Failure to follow this warning could result in serious injury or death in the event of a collision.				
2.	Follow the instructions in the INSTALLING THE STRUT section, Step 5.				
3.	Except at <b>Posts 1 and 2</b> , install the SYTP™ in a tube at locations required for the systems with the four (4) yielding holes (through the flange) at the top of the tube.				
4.	From the embankment side of the tube, insert a $\frac{5}{8}$ " x 9 $\frac{1}{2}$ " (16 mm x 240 mm) Hex Head Bolt (PN-3497G) through the tube, the Spacer (PN-4161), and the SYTP™.				
5.	Place a $\frac{5}{8}$ " (16 mm) HGR Nut (PN-3340G) on the inserted bolt, to secure the SYTP™ to the tube. <b>Note:</b> Do not over tighten the nut and deform the tube, this will complicate post replacement.				

## INSTALLING THE STRUT

Complete the following steps when installing the strut:

**Note: For All strut installations, the installer must provide a shallow valley/trough for installation of the strut, since a portion of the angle strut will be below grade.**

### INSTALLING THE STRUT WITH HBA™ POSTS/SYTP™

Complete the following steps to install the strut with HBA™ posts/SYTP™:

Step	Actions						
1.	Place the Angle Strut (PN-33875G for HBA™, or PN-33795G for HBA™/SYTP™) on the <b>outside flanges</b> of the HBA™ posts or the SYTP™ at <b>locations 1 and 2</b> . (Use PN-33875G with the HBA™ posts or the HBA™ post/SYTP™ in a tube. Use PN-33795G with the HBA™ post/SYTP™.)  <b>Note:</b> The strut can be placed with one of the legs flat on the ground or with the leg edge on the ground. The strut may be installed either on the traffic side or the field side of the posts.						
2.	Install a $\frac{3}{4}$ " (19 mm) diameter x $2\frac{1}{2}$ " (63 mm) Hex Head High Strength Bolt (PN-3717G) in the $\frac{13}{16}$ " (21 mm) hole of the HBA™ <b>Post 1</b> post plates. Place the bolt through the top and Bottom Post's post plates and through the strut.						
3.	Place a $\frac{3}{4}$ " (19 mm) Washer (PN-3700G) and a $\frac{3}{4}$ " (19 mm) Lockwasher under a $\frac{3}{4}$ " (19 mm) Hex Nut on the end of the bolt to secure.						
4.	Tighten the nuts to a snug position. (The designer does not recommend a torque requirement.)						
5.	Select Option A, Option B, or Option C below, for installing the strut on <b>post 2</b> : <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="text-align: center;"><b>Option A</b></td> <td><b>For HBA™ post at location 2</b> 1. Insert a <math>\frac{3}{4}</math>" (19 mm) diameter x 3" (75 mm) Hex Head High Strength Bolt (PN-3718G) through the strut, two or three <math>\frac{3}{4}</math>" (19 mm) Washers (PN-3701G), and the <math>\frac{13}{16}</math>" (21 mm) holes of the HBA™ post plates of <b>Post 2</b>. (The two or three washers allow the strut to pass over the <math>\frac{3}{8}</math>" (10 mm) bolt head.) 2. Place a <math>\frac{3}{4}</math>" (19 mm) washer and a <math>\frac{3}{4}</math>" (19 mm) Lockwasher (PN-4699G) under a <math>\frac{3}{4}</math>" (19 mm) Hex Nut (PN-3704G) on the inserted bolt. 3. Tighten the nuts to a snug position. The designer does not recommend a torque requirement for the HBA field assembly.</td> </tr> <tr> <td style="text-align: center;"><b>Option B</b></td> <td><b>For 6' SYTP™ only at location 2</b> 1. Place a <math>\frac{7}{16}</math>" (11 mm) Round Washer (PN-4389G) on the two (2) <math>\frac{7}{16}</math>" (11 mm) diameter x <math>1\frac{1}{2}</math>" (38 mm) Hex Head High Strength Bolts (PN-4390G). 2. Place the bolts in the two slotted holes of the strut and the yielding diameter holes of the SYTP™. 3. Place a Lockwasher (PN-4699G) under a <math>\frac{7}{16}</math>" Hex Nut (PN-3704G) on the ends of the inserted bolts. 4. Tighten the nuts to a snug position. (The designer does not recommend a torque requirement.)</td> </tr> <tr> <td style="text-align: center;"><b>Option C</b></td> <td><b>For 3' 6<math>\frac{5}{8}</math>" SYTP™ in tube at location 2</b> 1. Place a <math>\frac{3}{4}</math>" (19 mm) Washer (PN-3701G) on diameter x <math>9\frac{1}{2}</math>" (240 mm) Hex Head High Strength Bolt (PN-3718G). 2. From the embankment side, insert the bolt through the strut, foundation tube, Spacer (PN-4161), and the SYTP™. 3. Place a washer under a nut on the end of the inserted bolt. 4. Tighten the nuts to a snug position. (The designer does not recommend a torque requirement.)  <b>Note:</b> Do not over tighten the bolts and deform the tubes, this will complicate post replacement.</td> </tr> </tbody> </table>	<b>Option A</b>	<b>For HBA™ post at location 2</b> 1. Insert a $\frac{3}{4}$ " (19 mm) diameter x 3" (75 mm) Hex Head High Strength Bolt (PN-3718G) through the strut, two or three $\frac{3}{4}$ " (19 mm) Washers (PN-3701G), and the $\frac{13}{16}$ " (21 mm) holes of the HBA™ post plates of <b>Post 2</b> . (The two or three washers allow the strut to pass over the $\frac{3}{8}$ " (10 mm) bolt head.) 2. Place a $\frac{3}{4}$ " (19 mm) washer and a $\frac{3}{4}$ " (19 mm) Lockwasher (PN-4699G) under a $\frac{3}{4}$ " (19 mm) Hex Nut (PN-3704G) on the inserted bolt. 3. Tighten the nuts to a snug position. The designer does not recommend a torque requirement for the HBA field assembly.	<b>Option B</b>	<b>For 6' SYTP™ only at location 2</b> 1. Place a $\frac{7}{16}$ " (11 mm) Round Washer (PN-4389G) on the two (2) $\frac{7}{16}$ " (11 mm) diameter x $1\frac{1}{2}$ " (38 mm) Hex Head High Strength Bolts (PN-4390G). 2. Place the bolts in the two slotted holes of the strut and the yielding diameter holes of the SYTP™. 3. Place a Lockwasher (PN-4699G) under a $\frac{7}{16}$ " Hex Nut (PN-3704G) on the ends of the inserted bolts. 4. Tighten the nuts to a snug position. (The designer does not recommend a torque requirement.)	<b>Option C</b>	<b>For 3' 6<math>\frac{5}{8}</math>" SYTP™ in tube at location 2</b> 1. Place a $\frac{3}{4}$ " (19 mm) Washer (PN-3701G) on diameter x $9\frac{1}{2}$ " (240 mm) Hex Head High Strength Bolt (PN-3718G). 2. From the embankment side, insert the bolt through the strut, foundation tube, Spacer (PN-4161), and the SYTP™. 3. Place a washer under a nut on the end of the inserted bolt. 4. Tighten the nuts to a snug position. (The designer does not recommend a torque requirement.)  <b>Note:</b> Do not over tighten the bolts and deform the tubes, this will complicate post replacement.
<b>Option A</b>	<b>For HBA™ post at location 2</b> 1. Insert a $\frac{3}{4}$ " (19 mm) diameter x 3" (75 mm) Hex Head High Strength Bolt (PN-3718G) through the strut, two or three $\frac{3}{4}$ " (19 mm) Washers (PN-3701G), and the $\frac{13}{16}$ " (21 mm) holes of the HBA™ post plates of <b>Post 2</b> . (The two or three washers allow the strut to pass over the $\frac{3}{8}$ " (10 mm) bolt head.) 2. Place a $\frac{3}{4}$ " (19 mm) washer and a $\frac{3}{4}$ " (19 mm) Lockwasher (PN-4699G) under a $\frac{3}{4}$ " (19 mm) Hex Nut (PN-3704G) on the inserted bolt. 3. Tighten the nuts to a snug position. The designer does not recommend a torque requirement for the HBA field assembly.						
<b>Option B</b>	<b>For 6' SYTP™ only at location 2</b> 1. Place a $\frac{7}{16}$ " (11 mm) Round Washer (PN-4389G) on the two (2) $\frac{7}{16}$ " (11 mm) diameter x $1\frac{1}{2}$ " (38 mm) Hex Head High Strength Bolts (PN-4390G). 2. Place the bolts in the two slotted holes of the strut and the yielding diameter holes of the SYTP™. 3. Place a Lockwasher (PN-4699G) under a $\frac{7}{16}$ " Hex Nut (PN-3704G) on the ends of the inserted bolts. 4. Tighten the nuts to a snug position. (The designer does not recommend a torque requirement.)						
<b>Option C</b>	<b>For 3' 6<math>\frac{5}{8}</math>" SYTP™ in tube at location 2</b> 1. Place a $\frac{3}{4}$ " (19 mm) Washer (PN-3701G) on diameter x $9\frac{1}{2}$ " (240 mm) Hex Head High Strength Bolt (PN-3718G). 2. From the embankment side, insert the bolt through the strut, foundation tube, Spacer (PN-4161), and the SYTP™. 3. Place a washer under a nut on the end of the inserted bolt. 4. Tighten the nuts to a snug position. (The designer does not recommend a torque requirement.)  <b>Note:</b> Do not over tighten the bolts and deform the tubes, this will complicate post replacement.						

## INSTALLING THE STRUT WITH WOOD CRT POST IN TUBE AT POST 1 AND SYTP™/ SYTP™ IN TUBE AT POST 2

Complete the following steps to install the strut with wood post in soil tube at **Post 1** and SYTP™/ SYTP™ in tube at **Post 2**:

### AT POST 1

Step	Actions
1.	Place the angle strut (PN-33795G) on the embankment side of the SYTP™. (The strut can be placed with one of the legs flat on the ground or with the leg edge on the ground.)
2.	Place a $\frac{7}{16}$ " (11 mm) Round Washer (PN-4389G) on the two (2) $\frac{7}{16}$ " (11 mm) diameter x $1\frac{1}{2}$ " (38 mm) Hex Head High Strength Bolts (PN-4390G).
3.	Insert the two bolts through the two slotted holes of the strut and the yielding diameter holes of the SYTP™, at <b>Post 2</b> .
4.	Place a $\frac{7}{16}$ " (11 mm) Lockwasher (PN-4393G) under a $\frac{7}{16}$ " (11 mm) Hex Nut (PN-4388G) on the ends of the inserted bolts.
5.	Tighten the nuts to a snug position. (The designer does not recommend a torque requirement.)

### FOR ANGLE STRUT WITH 6' SYTP™ ONLY AT POST 2

Step	Actions
1.	Place the angle strut (PN-33795G) on the embankment side of the SYTP™. (The strut can be placed with one of the legs flat on the ground or with the leg edge on the ground.)
2.	Place a $\frac{7}{16}$ " (11 mm) Round Washer (PN-4389G) on the two (2) $\frac{7}{16}$ " (11 mm) diameter x $1\frac{1}{2}$ " (38 mm) Hex Head High Strength Bolts (PN-4390G).
3.	Insert the two bolts through the two slotted holes of the strut and the yielding diameter holes of the SYTP™, at <b>Post 2</b> .
4.	Place a $\frac{7}{16}$ " (11 mm) Lockwasher (PN-4393G) under a $\frac{7}{16}$ " (11 mm) Hex Nut (PN-4388G) on the ends of the inserted bolts.
5.	Tighten the nuts to a snug position. (The designer does not recommend a torque requirement.)

### FOR ANGLE STRUT WITH SYTP™ IN TUBE AT POST 2

Step	Actions
1.	Place the angle strut (PN-33795G) on the embankment side of the tube. (The strut can be placed with one of the legs flat on the ground or with the leg edge on the ground.)
2.	Place a $\frac{3}{4}$ " (19 mm) Washer (PN-3701G) on a $\frac{3}{4}$ " (19 mm) diameter x $9\frac{1}{2}$ " (240 mm) Hex Head High Strength Bolt (PN-4699G).
3.	From the embankment side, insert the bolt through the strut, foundation tube, Spacer (PN-4161), and the SYTP™ at <b>Post 2</b> .
4.	Place a $\frac{3}{4}$ " (19 mm) Washer (PN-3701G) under a $\frac{3}{4}$ " (19 mm) Hex Nut on the end of the inserted bolt.
5.	Tighten the nuts to a snug position. (The designer does not recommend a torque requirement.)  <b>Note:</b> Do not over tighten the bolts and deform the tubes, this will complicate possible post replacement.

## INSTALLING THE STRUT WITH WOOD POSTS IN SOIL TUBE

Complete the following steps to install the strut with wood posts in soil tubes:

Step	Actions						
1.	Select the Option A or Option B for installing the strut with wood posts in soil tubes: <table border="1" data-bbox="181 1963 932 2142"> <thead> <tr> <th>Option A</th> <th>For angle strut</th> </tr> </thead> <tbody> <tr> <td></td> <td>1. Place the angle strut (PN-33875G) on the embankment side of the foundation tubes.</td> </tr> <tr> <td></td> <td>2. Place a <math>\frac{3}{4}</math>" (19 mm) Washer (PN-3701G) on a <math>\frac{3}{4}</math>" (19 mm) diameter x <math>9\frac{1}{2}</math>" (240 mm) Hex Head High Strength Bolt (PN-5148G).</td> </tr> </tbody> </table>	Option A	For angle strut		1. Place the angle strut (PN-33875G) on the embankment side of the foundation tubes.		2. Place a $\frac{3}{4}$ " (19 mm) Washer (PN-3701G) on a $\frac{3}{4}$ " (19 mm) diameter x $9\frac{1}{2}$ " (240 mm) Hex Head High Strength Bolt (PN-5148G).
Option A	For angle strut						
	1. Place the angle strut (PN-33875G) on the embankment side of the foundation tubes.						
	2. Place a $\frac{3}{4}$ " (19 mm) Washer (PN-3701G) on a $\frac{3}{4}$ " (19 mm) diameter x $9\frac{1}{2}$ " (240 mm) Hex Head High Strength Bolt (PN-5148G).						

		<ol style="list-style-type: none"> <li>From the embankment side, insert the bolt through the strut, the foundation tube, and the wood post.</li> <li>Place a second washer under a <math>\frac{3}{4}</math>" (19 mm) Hex Nut (PN-3704G) on the end of the inserted bolt.</li> <li>Tighten the nuts to a snug position. (The designer does not recommend a torque requirement.)</li> </ol>
<b>Option B</b>	<b>For channel ground strut</b>	<ol style="list-style-type: none"> <li>Place the slotted yokes of the ground strut (PN-9852A) over the foundation tubes, at the base of <b>Posts 1 and 2</b>.</li> <li>Place a <math>\frac{5}{8}</math>" (16 mm) Round Washer (PN-3300G) on a <math>\frac{5}{8}</math>" (16 mm) diameter x <math>9\frac{1}{2}</math>" (240 mm) Hex Head Bolt (PN-3497G).</li> <li>From the embankment side, insert the bolt through the strut, foundation tube, and the wood post.</li> <li>Place a second washer under a <math>\frac{5}{8}</math>" (16 mm) HGR Hex Nut on the end of the inserted bolt.</li> <li>Tighten the nuts to a snug position. (The designer does not recommend a torque requirement.)</li> </ol>

**Note:** Do not over tighten the bolts and deform the tubes, this will complicate possible post replacement.

## INSTALLING OFFSET BLOCKS AND RAIL PANELS

The ET-PLUS™ systems use 25' 0" (7.62 m) rail panels (PN-60G and/or PN-62G) or 12' 6" (3.81 m) rail panels (PN-9G and/or PN-32G). The state/specifying agency standards must be reviewed for what systems to use.



**WARNING:** Do NOT bolt the rail panel to the post at **location 1** in any of the ET-PLUS™ systems. Failure to follow this warning could result in serious injury or death in the event of a collision.



**WARNING:** Do NOT bolt the rail to the HBA™ post at **location 2**. Failure to follow this warning could result in serious injury or death in the event of a collision.

## SPLICING THE RAIL PANELS

Complete the following steps to splice the rail panels:

Step	Actions
1.	Lap the terminal rail in the direction of traffic, unless the state/specifying agency's policy dictates otherwise.
2.	Splice the rail panels together with eight (8) $\frac{5}{8}$ " x $1\frac{1}{4}$ " (16 mm x 32 mm), HGR Splice Bolts (PN-3360G), and $\frac{5}{8}$ " (16 mm) HGR Hex Nuts.
3.	Tighten the bolts. (There is no torque requirement.)

## INSTALLING THE OFFSET BLOCK AND RAIL PANEL TO WOOD POSTS (POSTS 3 THROUGH 7 OR 8)

Complete the following steps to attach the offset blocks and rail panels to the wood post:

Step	Actions		
1.	<p>At locations with wood posts and wood blocks, insert a <math>\frac{5}{8}</math>" (16 mm) diameter x 18" (460 mm) HGR Post Bolt (PN-3580G) through the rail panel, offset block (PN-4075B), and the post.</p> <p><b>Note:</b> Offset blocks are <b>NOT</b> used at <b>post locations 1 and 2</b>, but are used at all other locations.</p> <table border="1"> <tr> <td></td> <td><b>WARNING:</b> Do NOT bolt the rail panel to the post at <b>location 1</b> in any of the ET-PLUS™ systems. Failure to follow this warning could result in serious injury or death in the event of a collision.</td> </tr> </table>		<b>WARNING:</b> Do NOT bolt the rail panel to the post at <b>location 1</b> in any of the ET-PLUS™ systems. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Do NOT bolt the rail panel to the post at <b>location 1</b> in any of the ET-PLUS™ systems. Failure to follow this warning could result in serious injury or death in the event of a collision.		
2.	Place a $\frac{5}{8}$ " (16 mm) Round Washer (PN-3300G) under a $\frac{5}{8}$ " (16 mm) HGR Nut (PN-3340G).		
3.	Tighten the bolts. (There is no torque requirement for these bolts.)		
4.	Secure the offset block by toe nailing the block to the post or the post to the block, with two (2) 16d hot-dipped galvanized nails approximately 3" (75 mm) from the top of the post or block, one on each side, to prevent it from rotating.		

## INSTALLING THE OFFSET BLOCK AND RAIL PANEL TO HBA™ POSTS OR SYTP™ (POSTS 3 THROUGH 7 OR 8)

Complete the following steps to attach the offset blocks and rail panels to the HBA™ post or SYTP™:

Step	Actions				
1.	<p>At locations with HBA Posts or SYTP™ with wood blocks, insert a <math>\frac{5}{8}</math>" (16 mm) diameter x 10" (255 mm) HGR Post Bolt (PN-3500G) through the rail panel, Routed Wood (PN-4076B) or Composite Blockout, and the HBA™ post or SYTP™.</p> <p><b>Note:</b> Offset blocks are <b>NOT</b> used at <b>post locations 1 and 2</b>. For SYTP™ stubs, there are two (2) sets of holes in the SYTP™ for attaching the rail. Use the holes in the SYTP™ stub that will place the rail at the correct height.</p> <table border="1"> <tr> <td></td> <td><b>WARNING:</b> Do NOT bolt the rail panel to the post at <b>location 1</b> in any of the ET-PLUS™ systems. Failure to follow this warning could result in serious injury or death in the event of a collision.</td> </tr> <tr> <td></td> <td><b>WARNING:</b> Ensure all wood blocks or composite blocks used with steel posts are routed. Failure to follow this warning could result in serious injury or death in the event of a collision.</td> </tr> </table>		<b>WARNING:</b> Do NOT bolt the rail panel to the post at <b>location 1</b> in any of the ET-PLUS™ systems. Failure to follow this warning could result in serious injury or death in the event of a collision.		<b>WARNING:</b> Ensure all wood blocks or composite blocks used with steel posts are routed. Failure to follow this warning could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Do NOT bolt the rail panel to the post at <b>location 1</b> in any of the ET-PLUS™ systems. Failure to follow this warning could result in serious injury or death in the event of a collision.				
	<b>WARNING:</b> Ensure all wood blocks or composite blocks used with steel posts are routed. Failure to follow this warning could result in serious injury or death in the event of a collision.				
2.	Place a $\frac{5}{8}$ " (16 mm) Round Washer (PN-3300G) under a $\frac{5}{8}$ " (16 mm) HGR Nut (PN-3340G) on the inserted bolt.				
3.	Tighten the bolts. (There is no torque requirement for these bolts.)				

## INSTALLING THE RAIL PANEL TO THE POST WITHOUT OFFSET BLOCK AT POST 2

Complete the following steps to attach the rail panel to the post without offset block at **Post 2**:

Step	Actions								
1.	Select the Option A, Option B, or Option C to install the rail panel without offset block at <b>Post 2</b> :								
	<table border="1"> <tr> <td style="text-align: center; vertical-align: middle;"> <b>Option A</b> For Wood Post                 </td> <td>                     1. Insert a <math>\frac{5}{8}</math>" (16 mm) diameter x 10" (255 mm) HGR Post Bolt (PN-3500G) through the rail and the wood post at <b>location 2</b>.                      2. Place a <math>\frac{5}{8}</math>" (16 mm) Round Washer (PN-3300G) under a <math>\frac{5}{8}</math>" (16 mm) HGR Nut (PN-3340G) on the inserted bolt. Tighten the bolts. (There is no torque requirement for these bolts.)                 </td> </tr> <tr> <td style="text-align: center; vertical-align: middle;"> <b>Option B</b> For SYTP™                 </td> <td>                     1. Insert a <math>\frac{5}{8}</math>" (16 mm) diameter x 1<math>\frac{1}{4}</math>" (31 mm) HGR Bolt (PN-3360G) through the rail panel and the hole in the SYTP™.   <b>Note:</b> For SYTP stubs, use the hole in the SYTP™ that will place the rail at the correct height. (If there are two (2) sets of holes in the SYTP™ stub for attaching the rail.)                      2. Place a <math>\frac{5}{8}</math>" (16 mm) Round Washer (PN-3300G) under a <math>\frac{5}{8}</math>" (16 mm) HGR Nut (PN-3340G) on the inserted bolt.                 </td> </tr> <tr> <td style="text-align: center; vertical-align: middle;"> <b>Option C</b> For HBA™ Post                 </td> <td>                     1. Do NOT bolt the rail panel to the HBA™ post at <b>location 2</b>.   <table border="1" style="width: 100%;"> <tr> <td style="text-align: center; vertical-align: middle;">  </td> <td> <b>WARNING:</b> Do NOT bolt the rail to the HBA™ post at <b>location 2</b>. Failure to follow this warning could result in serious injury or death in the event of a collision.                     </td> </tr> </table> </td> </tr> </table>	<b>Option A</b> For Wood Post	1. Insert a $\frac{5}{8}$ " (16 mm) diameter x 10" (255 mm) HGR Post Bolt (PN-3500G) through the rail and the wood post at <b>location 2</b> . 2. Place a $\frac{5}{8}$ " (16 mm) Round Washer (PN-3300G) under a $\frac{5}{8}$ " (16 mm) HGR Nut (PN-3340G) on the inserted bolt. Tighten the bolts. (There is no torque requirement for these bolts.)	<b>Option B</b> For SYTP™	1. Insert a $\frac{5}{8}$ " (16 mm) diameter x 1 $\frac{1}{4}$ " (31 mm) HGR Bolt (PN-3360G) through the rail panel and the hole in the SYTP™.  <b>Note:</b> For SYTP stubs, use the hole in the SYTP™ that will place the rail at the correct height. (If there are two (2) sets of holes in the SYTP™ stub for attaching the rail.) 2. Place a $\frac{5}{8}$ " (16 mm) Round Washer (PN-3300G) under a $\frac{5}{8}$ " (16 mm) HGR Nut (PN-3340G) on the inserted bolt.	<b>Option C</b> For HBA™ Post	1. Do NOT bolt the rail panel to the HBA™ post at <b>location 2</b> .  <table border="1" style="width: 100%;"> <tr> <td style="text-align: center; vertical-align: middle;">  </td> <td> <b>WARNING:</b> Do NOT bolt the rail to the HBA™ post at <b>location 2</b>. Failure to follow this warning could result in serious injury or death in the event of a collision.                     </td> </tr> </table>		<b>WARNING:</b> Do NOT bolt the rail to the HBA™ post at <b>location 2</b> . Failure to follow this warning could result in serious injury or death in the event of a collision.
<b>Option A</b> For Wood Post	1. Insert a $\frac{5}{8}$ " (16 mm) diameter x 10" (255 mm) HGR Post Bolt (PN-3500G) through the rail and the wood post at <b>location 2</b> . 2. Place a $\frac{5}{8}$ " (16 mm) Round Washer (PN-3300G) under a $\frac{5}{8}$ " (16 mm) HGR Nut (PN-3340G) on the inserted bolt. Tighten the bolts. (There is no torque requirement for these bolts.)								
<b>Option B</b> For SYTP™	1. Insert a $\frac{5}{8}$ " (16 mm) diameter x 1 $\frac{1}{4}$ " (31 mm) HGR Bolt (PN-3360G) through the rail panel and the hole in the SYTP™.  <b>Note:</b> For SYTP stubs, use the hole in the SYTP™ that will place the rail at the correct height. (If there are two (2) sets of holes in the SYTP™ stub for attaching the rail.) 2. Place a $\frac{5}{8}$ " (16 mm) Round Washer (PN-3300G) under a $\frac{5}{8}$ " (16 mm) HGR Nut (PN-3340G) on the inserted bolt.								
<b>Option C</b> For HBA™ Post	1. Do NOT bolt the rail panel to the HBA™ post at <b>location 2</b> .  <table border="1" style="width: 100%;"> <tr> <td style="text-align: center; vertical-align: middle;">  </td> <td> <b>WARNING:</b> Do NOT bolt the rail to the HBA™ post at <b>location 2</b>. Failure to follow this warning could result in serious injury or death in the event of a collision.                     </td> </tr> </table>		<b>WARNING:</b> Do NOT bolt the rail to the HBA™ post at <b>location 2</b> . Failure to follow this warning could result in serious injury or death in the event of a collision.						
	<b>WARNING:</b> Do NOT bolt the rail to the HBA™ post at <b>location 2</b> . Failure to follow this warning could result in serious injury or death in the event of a collision.								

## INSTALLING THE CABLE ANCHOR ASSEMBLY

The Cable Anchor Bracket (PN-704A) is secured to the rail panel, by inserting the square protruding hooks/lugs on the bracket into the square slots in the rail panel. The Cable Anchor Bracket is locked into place, by pulling the bracket towards the impact end of the unit, making sure the hooks/lugs are well seated into the square holes.

Complete the following steps to install the cable anchor assembly:

Step	Actions		
1.	Slide one end of the cable (PN-3000G) into the Cable Anchor Bracket and the other end through <b>Post 1</b> .		
2.	Place a 1" (25 mm) Washer (PN-3900G) and 1" (25 mm) Hex Nut (PN-3910G) on the end of the cable that extends through the Cable Anchor Bracket. Turn the nut, until at least 2 threads are completely through the nut.		
3.	Place the Bearing Plate (PN-782G) on the impact side of <b>Post 1</b> where the cable extends through the post. <b>The cable bearing plate MUST BE oriented with the "long" dimension turned up. The hole in the bearing plate is off center (in the vertical direction), 5" (125 mm) from one edge and 3" (75 mm) from the opposite edge.</b>		
4.	<p>If applying the Bearing Plate (PN-782G) to a wood post at <b>Post 1</b>, drive two nails along the top edge of the Bearing Plate and bend over to prevent the Bearing Plate from rotating.</p> <table border="1" style="width: 100%;"> <tr> <td style="text-align: center; vertical-align: middle;">  </td> <td> <b>WARNING:</b> Any grout, backfill, or other materials (such as concrete, asphalt, or soil) must be low enough so as not to obstruct, constrain, or otherwise engage the bearing plate. Failure to eliminate the interaction of soil or materials with the bearing plate will hinder the performance of the ET-PLUS™ systems and could result in serious injury or death in the event of a collision.                     </td> </tr> </table>		<b>WARNING:</b> Any grout, backfill, or other materials (such as concrete, asphalt, or soil) must be low enough so as not to obstruct, constrain, or otherwise engage the bearing plate. Failure to eliminate the interaction of soil or materials with the bearing plate will hinder the performance of the ET-PLUS™ systems and could result in serious injury or death in the event of a collision.
	<b>WARNING:</b> Any grout, backfill, or other materials (such as concrete, asphalt, or soil) must be low enough so as not to obstruct, constrain, or otherwise engage the bearing plate. Failure to eliminate the interaction of soil or materials with the bearing plate will hinder the performance of the ET-PLUS™ systems and could result in serious injury or death in the event of a collision.		
5.	Place a 1" (25 mm) washer under a nut on the end of the cable extending through <b>Post 1</b> .		
6.	Restrain the cable with locking pliers at the end being tightened, to avoid twisting the cable.		
7.	Tighten the Hex Nuts on the cable ends, until the cable is taut.		

	The cable is considered taut, when it does not deflect more than 1 inch when pressure is applied by hand in an up or down direction.
8.	<b>The shank portion of the anchor cable MUST BE positioned so it bears on the bottom edge of the web of the HBA post. The shank portion of the anchor cable must also be centered horizontally so that the bearing plate bears uniformly on both flanges of Post 1.</b>

## INSTALLING THE ET-PLUS™ EXTRUDER (HEAD)

Complete the following steps to install the ET-PLUS™ Extruder (Head):

Step	Actions				
1.	Place the ET-PLUS™ Extruder (Head (PN-995A)) over the end of the rail panel as the final piece to attach to the assembly. <b>Note:</b> The ET-PLUS™ Extruder (Head) can be used on the left or right hand shoulder.				
2.	Push the ET-PLUS™ Extruder (Head) as far as it will go on the rail panel, making sure the rail is in the channel chute.				
3.	Install the ET-PLUS™ Extruder channel chute approximately parallel to the ground. The attachment brackets have 3 holes in each bracket to provide tolerance in the installation.				
4.	Select the Option A or Option B for the ET-PLUS™ Extruder (Head) installation: <table border="1" data-bbox="184 892 940 1701"> <tr> <td><b>Option A</b></td> <td><b>For Wood post</b> <ol style="list-style-type: none"> <li>Place the ET-PLUS™ Extruder (Head) against the wood post, at <b>location 1</b>.</li> <li>Choose the hole in the bracket that is closest to the center of the post.</li> <li>Drill a <math>\frac{1}{4}</math>" (6 mm) pilot hole to avoid breaking the lag screw during installation.</li> <li>Screw one (1) <math>\frac{3}{8}</math>" (10 mm) diameter x 4" (100 mm) Lag Screw (PN-4228B) in the top and bottom bracket. The lag screw must be screwed into the post to prevent it from pulling out or cracking the post.</li> </ol> </td> </tr> <tr> <td><b>Option B</b></td> <td><b>For HBA™ post</b> <ol style="list-style-type: none"> <li>Place the ET-PLUS™ Extruder (Head) against the HBA™ post, at <b>location 1</b>.</li> <li>Place a <math>\frac{3}{8}</math>" (10 mm) Round Washer (PN-4254G) on a <math>\frac{3}{8}</math>" (10 mm) diameter x <math>1\frac{1}{2}</math>" (38 mm) Hex Head Bolt (PN-4261G).</li> <li>Insert the bolt through the flange of the ET-PLUS™ Extruder (Head) and the flange of HBA™ post.</li> <li>Place a <math>\frac{3}{8}</math>" (10 mm) Fender Washer (PN-4255G) under a <math>\frac{3}{8}</math>" (10 mm) Nut (PN-6405G) on the end of the inserted bolt.</li> <li>Tighten the nuts to a snug position. The designer does not recommend a torque requirement for the HBA field assembly.</li> </ol> </td> </tr> </table>	<b>Option A</b>	<b>For Wood post</b> <ol style="list-style-type: none"> <li>Place the ET-PLUS™ Extruder (Head) against the wood post, at <b>location 1</b>.</li> <li>Choose the hole in the bracket that is closest to the center of the post.</li> <li>Drill a <math>\frac{1}{4}</math>" (6 mm) pilot hole to avoid breaking the lag screw during installation.</li> <li>Screw one (1) <math>\frac{3}{8}</math>" (10 mm) diameter x 4" (100 mm) Lag Screw (PN-4228B) in the top and bottom bracket. The lag screw must be screwed into the post to prevent it from pulling out or cracking the post.</li> </ol>	<b>Option B</b>	<b>For HBA™ post</b> <ol style="list-style-type: none"> <li>Place the ET-PLUS™ Extruder (Head) against the HBA™ post, at <b>location 1</b>.</li> <li>Place a <math>\frac{3}{8}</math>" (10 mm) Round Washer (PN-4254G) on a <math>\frac{3}{8}</math>" (10 mm) diameter x <math>1\frac{1}{2}</math>" (38 mm) Hex Head Bolt (PN-4261G).</li> <li>Insert the bolt through the flange of the ET-PLUS™ Extruder (Head) and the flange of HBA™ post.</li> <li>Place a <math>\frac{3}{8}</math>" (10 mm) Fender Washer (PN-4255G) under a <math>\frac{3}{8}</math>" (10 mm) Nut (PN-6405G) on the end of the inserted bolt.</li> <li>Tighten the nuts to a snug position. The designer does not recommend a torque requirement for the HBA field assembly.</li> </ol>
<b>Option A</b>	<b>For Wood post</b> <ol style="list-style-type: none"> <li>Place the ET-PLUS™ Extruder (Head) against the wood post, at <b>location 1</b>.</li> <li>Choose the hole in the bracket that is closest to the center of the post.</li> <li>Drill a <math>\frac{1}{4}</math>" (6 mm) pilot hole to avoid breaking the lag screw during installation.</li> <li>Screw one (1) <math>\frac{3}{8}</math>" (10 mm) diameter x 4" (100 mm) Lag Screw (PN-4228B) in the top and bottom bracket. The lag screw must be screwed into the post to prevent it from pulling out or cracking the post.</li> </ol>				
<b>Option B</b>	<b>For HBA™ post</b> <ol style="list-style-type: none"> <li>Place the ET-PLUS™ Extruder (Head) against the HBA™ post, at <b>location 1</b>.</li> <li>Place a <math>\frac{3}{8}</math>" (10 mm) Round Washer (PN-4254G) on a <math>\frac{3}{8}</math>" (10 mm) diameter x <math>1\frac{1}{2}</math>" (38 mm) Hex Head Bolt (PN-4261G).</li> <li>Insert the bolt through the flange of the ET-PLUS™ Extruder (Head) and the flange of HBA™ post.</li> <li>Place a <math>\frac{3}{8}</math>" (10 mm) Fender Washer (PN-4255G) under a <math>\frac{3}{8}</math>" (10 mm) Nut (PN-6405G) on the end of the inserted bolt.</li> <li>Tighten the nuts to a snug position. The designer does not recommend a torque requirement for the HBA field assembly.</li> </ol>				

## DELINEATION OPTION FOR THE ET-PLUS™

Install high intensity reflective sheeting (PN-6206B [Right Side] or PN-6207B [Left Side]) on the front face of the ET-PLUS™ Extruder (Head), per the state/specifying agency's MUTCD for options or proper delineation. Alternate reflective sheeting is PN-6668B. The alternate reflective sheeting requires two pieces and must be rotated for proper delineation.

**Note:** The reflective sheeting is an option to the ET-PLUS™ and needs to be ordered separate from the ET-PLUS™ package.



**WARNING:** Ensure that your installation, repair, and maintenance meet all appropriate Manual on Uniform Traffic Control Devices (MUTCD) and local standards. Failure to follow this warning could result in serious injury or death in the event of a collision.

## INSTALLATION CHECKLIST

STATE: \_\_\_\_\_ PROJECT: \_\_\_\_\_

DATE: \_\_\_\_\_ LOCATION: \_\_\_\_\_

- The Leaveout (specified area of open space in the pavement) around the posts is reserved and filled with state/specifying agency approved backfill material that will not prevent movement, for any posts installed in rigid pavement such as any thickness of concrete or asphalt.
- The finished Guardrail height is approximately 27<sup>3</sup>/<sub>4</sub>" above the finished grade, or as the state/specifying agency plans indicate.
- Any site grading needed was completed, before the start of the installation of the ET-PLUS™ systems.
- The steel tubes or post plates (ears) to the HBA™ Bottom Posts do not protrude more than 4" (100 mm) above the finished grade measured by the American Association of State Highway and Transportation Officials ("AASHTO") 5' (1.5 m) cord method. Site grading may be necessary to meet this requirement.
- The <sup>3</sup>/<sub>4</sub>" bolts connecting the tops of the HBA™ Bottom Posts to the bottoms of the HBA™ Top Posts are tightened to a snug position. The designer does not recommend a torque requirement for the HBA field assembly.
- The <sup>5</sup>/<sub>8</sub>" bolts connecting the tops of the HBA™ Bottom Posts to the bottoms of the HBA™ Top Posts are tightened to a snug position. The designer does not recommend a torque requirement for the HBA field assembly.
- The bolts at the top of the steel tubes are not over tightened. The walls of the steel tubes are not collapsed.
- If an angle strut was utilized, the bolts connecting the angle strut are HIGH STRENGTH.
- The ET-PLUS™ Extruder (Head) is pushed as far as it will go on the rail panel, ensuring the panels fully engage with the channel chute.
- The two bolts holding the ET-PLUS™ Extruder (Head) to **Post 1** are snug and the Extruder channel chute is approximately parallel to the finished grade.
- The Cable Anchor Bracket is locked into place, by pulling the bracket towards the impact end of the unit, making sure the hooks/lugs are well seated into the square holes.
- The shank portion of the anchor cable **MUST BE** positioned vertically, up flush against the bottom web of the top section of the HBA post. The shank portion of the cable **MUST** also be centered horizontally so that the bearing plate bears uniformly on both flanges of **Post 1**.
- Any grout, backfill, or other materials (such as concrete, asphalt, or soil) must be low enough so as not to obstruct, constrain, or otherwise engage the bearing plate.
- The Hex Nuts on the cable ends are tighten, until the cable is taut. The cable is considered taut, when it does not deflect more than 1 inch when pressure is applied by hand in an up or down direction.
- The Bearing Plate (PN-782G) is placed on the impact side of **Post 1** where the cable extends through the post. The cable bearing plate **MUST BE** oriented with the "long" dimension turned up. The hole in the bearing plate is off center (in the vertical direction), 5" (125 mm) from one edge and 3" (75 mm) from the opposite edge.
- The top surfaces of any grout or other backfill placed in the mowstrip "leave out" must be low enough so that it does not engage the bearing plate or otherwise obstruct/constrain the 3/8" shear bolts or the 3/4" hinge bolts of the HBA Post
- Any wood offset blocks used have been toe nailed to the wood posts.
- If backfilled, the backfill material around the posts is properly compacted.
- Each HBA™ post has two bolts on either side of the post with the larger bolt downstream of the smaller bolt (away from the impact head).
- The SYTP™ holes are at the finished grade.
- The CRT post has two 3<sup>1</sup>/<sub>2</sub>" (90 mm) breakaway holes (checked prior to installation). They are located parallel to the roadway with the top hole located approximately at the finished grade.
- The tube bolts are installed with the nuts on the pavement side of the tube for ease of future removal.
- The rail panels are lapped correctly and not attached to the posts at locations identified for the system installed.
- The reflective sheeting is correctly positioned on the Extruder face.
- Ensure that this installation conforms with the guidance provided by the AASHTO Roadside Design Guide, including, but not limited to, those regarding placement on curbs.

## MAINTENANCE AND REPAIR INSTRUCTIONS

### \* IMPORTANT MAINTENANCE AND REPAIR INSTRUCTIONS \*

Always keep the Manual in a location where it is easily accessed by persons who install, maintain, or repair the ET-PLUS™ systems. If you have any questions concerning the information in this Manual or about the ET-Plus™ systems, contact the state/specifying agency, then Trinity Highway Products, LLC. at 800-527-6050.

	<p><b>WARNING:</b> Use only Trinity Highway Products' parts on the ET-PLUS™ systems for installation, maintenance, or repair. The installation or co-mingling of unauthorized parts is strictly prohibited. Failure to follow this warning could result in 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"). The ET-PLUS™ systems and its component parts have been accepted for state use by FHWA. However, a co-mingled system has not been accepted.</p>
	<p><b>WARNING:</b> Ensure that the necessary traffic control is setup and any debris that has encroached onto the traveled way or shoulder has been removed, before beginning installation or repairs. Failure to follow this warning could result in serious injury or death in the event of a collision.</p>
	<p><b>WARNING:</b> Safety measures, incorporating traffic control devices, must be used to protect all personnel while at the installation, maintenance, or repair site. Failure to follow this warning could result in serious injury or death to the workers and/or bystanders. Trinity Highway Products offers an economical and effective truck mounted attenuator, the MPS-350, for the protection of workers in work zones. For more information on the MPS-350, call 800-644-7976 or visit the Trinity Highway Products website at <a href="http://www.highwayguardrail.com">www.highwayguardrail.com</a>.</p>
	<p><b>WARNING:</b> Do NOT perform installation, maintenance, or repair if the ET-PLUS™ systems site, shoulder, or traveled area are covered or encroached by road debris. Failure to follow this warning could result in serious injury or death in the event of a collision.</p>
	<p><b>WARNING:</b> Ensure that all Guardrail products and delineation used meet all federal, state/specifying agency, and local specifications. Failure to follow this warning could result in serious injury or death in the event of a collision.</p>

### MAINTENANCE

Complete the following steps, periodically, to check the safety of the system:

Step	Actions
<p>1.</p>	<p>Ensure the nuts have not been removed from the cable. Replace nuts, if needed.</p> <div data-bbox="181 1589 937 1875" style="border: 1px solid black; padding: 5px;">  <p><b>WARNING:</b> Use only Trinity Highway Products' parts on the ET-PLUS™ systems for installation, maintenance, or repair. The installation or co-mingling of unauthorized parts is strictly prohibited. Failure to follow this warning could result in 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"). The ET-PLUS™ systems and its component parts have been accepted for state use by FHWA. However, a co-mingled system has not been accepted.</p> </div>
<p>2.</p>	<p><b>Ensure the end fitting on the anchor cable MUST BE positioned vertically, up flush against the bottom web of the top section of the post. The end fitting of the cable MUST BE centered horizontally so that the bearing plate bears uniformly on both flanges of Post 1.</b></p>
<p>3.</p>	<p>Ensure the cable is taut. The cable is considered taut, when it does not deflect more than 1 inch when pressure is applied by hand in an up or down direction. Tighten, if needed.</p>
<p>4.</p>	<p><b>Ensure the bearing plate has not rotated.</b>  <b>Note: The cable bearing plate MUST BE oriented with the "long" dimension turned up. The hole in the bearing plate is</b></p>

	<b>off center (in the vertical direction), 5" (125 mm) from one edge and 3" (75 mm) from the opposite edge.</b>
5.	Ensure wood blocks are in place and in good condition, as defined by the state/specifying agency.
6.	Ensure the blockouts have not rotated. Correct the blockout position and reinstall the 16d hot-dipped galvanized nails, if needed.

## REPAIR

Complete the following steps to repair the ET-PLUS™ systems:

Step	Actions				
1.	<p>Setup necessary traffic control at the accident site and then, remove any debris that has encroached onto the traveled way or shoulder.</p> <table border="1"> <tr> <td></td> <td><b>WARNING:</b> Ensure that the necessary traffic control is setup and any debris that has encroached onto the traveled way or shoulder has been removed, before beginning installation or repairs. Failure to follow this warning could result in serious injury or death in the event of a collision.</td> </tr> <tr> <td></td> <td><b>WARNING:</b> Safety measures, incorporating traffic control devices, must be used to protect all personnel while at the installation, maintenance, or repair site. Failure to follow this warning could result in serious injury or death to the workers and/or bystanders. Trinity Highway Products offers an economical and effective truck mounted attenuator, the MPS-350, for the protection of workers in work zones. For more information on the MPS-350, call 800-644-7976 or visit the Trinity Highway Products website at <a href="http://www.highwayguardrail.com">www.highwayguardrail.com</a>.</td> </tr> </table>		<b>WARNING:</b> Ensure that the necessary traffic control is setup and any debris that has encroached onto the traveled way or shoulder has been removed, before beginning installation or repairs. Failure to follow this warning could result in serious injury or death in the event of a collision.		<b>WARNING:</b> Safety measures, incorporating traffic control devices, must be used to protect all personnel while at the installation, maintenance, or repair site. Failure to follow this warning could result in serious injury or death to the workers and/or bystanders. Trinity Highway Products offers an economical and effective truck mounted attenuator, the MPS-350, for the protection of workers in work zones. For more information on the MPS-350, call 800-644-7976 or visit the Trinity Highway Products website at <a href="http://www.highwayguardrail.com">www.highwayguardrail.com</a> .
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2.	Take inventory of the damaged systems and determine what parts are reusable, as defined by the state/specifying agency and what parts need to be replaced.				
3.	Check the ET-PLUS™ Extruder (Head) for damage. (It is normally reusable.)				
4.	Check the anchor cable and Cable Anchor Bracket for damage. (The Bearing Plate, nuts, washers, and Cable Anchor Bracket are rarely damaged.)				
5.	<p>Obtain the Trinity Highway Products' parts that need to be replaced from Trinity Highway Products, LLC. (See TOOLS REQUIRED section for list of recommended tools for the repair of the ET-PLUS™ systems.)</p> <table border="1"> <tr> <td></td> <td><b>WARNING:</b> Use only Trinity Highway Products' parts on the ET-PLUS™ systems for installation, maintenance, or repair. The installation or co-mingling of unauthorized parts is strictly prohibited. Failure to follow this warning could result in 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"). The ET-PLUS™ systems and its component parts have been accepted for state use by FHWA. However, a co-mingled system has not been accepted.</td> </tr> </table>		<b>WARNING:</b> Use only Trinity Highway Products' parts on the ET-PLUS™ systems for installation, maintenance, or repair. The installation or co-mingling of unauthorized parts is strictly prohibited. Failure to follow this warning could result in 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"). The ET-PLUS™ systems and its component parts have been accepted for state use by FHWA. However, a co-mingled system has not been accepted.		
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6.	Return to the repair site with the replacement parts and tools needed.				
7.	Cut off the <b>extruded</b> rail near the ET-PLUS™ Extruder (Head). Do not cut the ET-PLUS™ Extruder (Head) from the non-extruded rail.				
8.	Secure a chain to the ET-PLUS™ Extruder (Head).				
9.	Attach the chain to a truck frame while the other end of the rail is still connected to the downstream posts (away from the impact head) to provide anchorage.				
10.	Pull the ET-PLUS™ Extruder (Head) off the rail.				
11.	Remove any damaged rail.				
12.	Remove the broken posts from the steel tubes.				
13.	Remove all damaged CRT, SYTP™, or HBA™ posts. Undamaged HBA™ posts can be reset.				
14.	Remove and discard any rubber bumpers or construction legs				

	encountered on damaged systems.		
<b>15.</b>	<p>Reconstruct the systems following the installation instructions, after the site has been cleared of damaged debris.</p> <table border="1"> <tr> <td></td> <td><b>WARNING:</b> Do NOT perform installation, maintenance, or repair if the ET-PLUS™ systems site, shoulder, or traveled area are covered or encroached by road debris. Failure to follow this warning could result in serious injury or death in the event of a collision.</td> </tr> </table>		<b>WARNING:</b> Do NOT perform installation, maintenance, or repair if the ET-PLUS™ systems site, shoulder, or traveled area are covered or encroached by road debris. Failure to follow this warning could result in serious injury or death in the event of a collision.
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<b>16.</b>	<p>Install proper delineation for the repaired systems in accordance with the state/specifying agency's MUTCD.</p> <table border="1"> <tr> <td></td> <td><b>WARNING:</b> Ensure that all Guardrail products and delineation used meet all federal, state/specifying agency, and local specifications. Failure to follow this warning could result in serious injury or death in the event of a collision.</td> </tr> </table>		<b>WARNING:</b> Ensure that all Guardrail products and delineation used meet all federal, state/specifying agency, and local specifications. Failure to follow this warning could result in serious injury or death in the event of a collision.
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