

# Installation Instructions

Wood and Steel Post Options



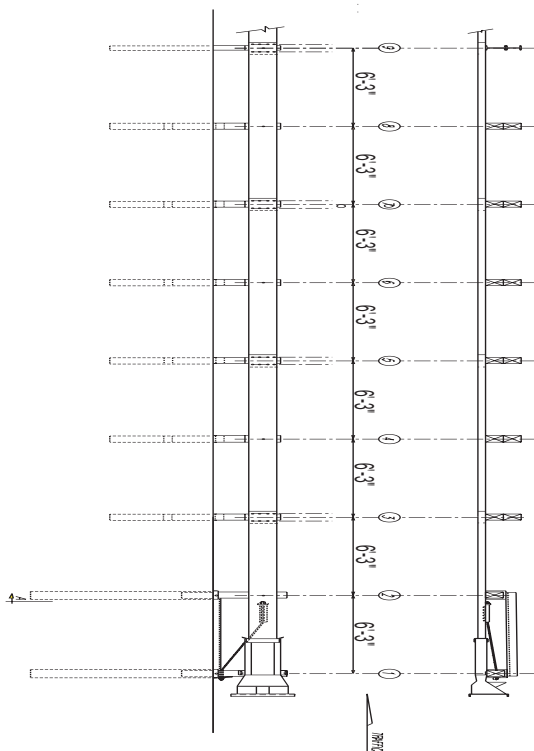
**ET-PLUS™**  
Guardrail End Treatment  
Revised July 2005

 **TRINITY**  
HIGHWAY SAFETY PRODUCTS, INC.

**BUILDING TOMORROW'S HIGHWAY  
SAFETY SOLUTIONS TODAY**

**ET- PLUS™****50'0" (15.24 m) System**

FOR SPECIFIC DETAILS, REFER TO THE TRINITY ET  
DRAWING(S) AND STATE STANDARD DRAWING



(This represents 1 version of the 50'0" (15.24 m) system)

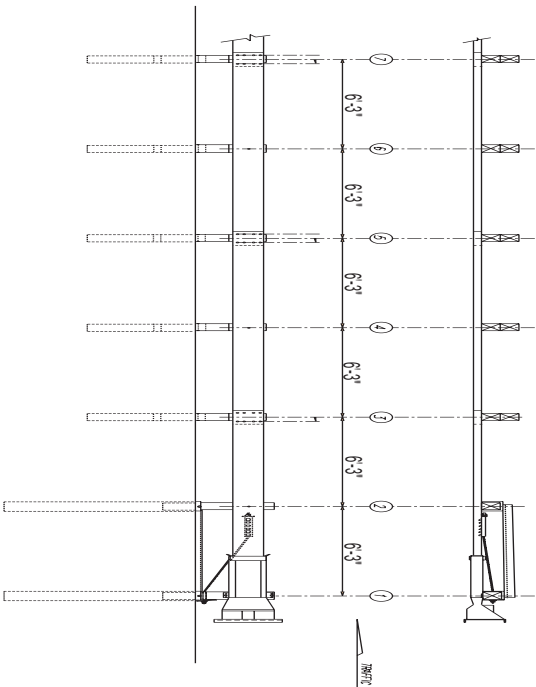
**NOTES:**

1. Alternate to long foundation tube without soil plate is short tube with soil plate at locations 1 and 2, Hinged Breakaway (HBA) Post™ at locations 1 and 2, or Hinged Breakaway (HBA) Post™ at location 1 and Steel Yielding Terminal Post™ (SYTP) at location 2; long foundation tube or short tube with soil plate at location 1 and SYTP at location 2.
2. Alternate to two 12'6" (3.81 m) long rail elements is one 25'0" (7.62 m) long rail element.
3. Short steel foundation tubes without soil plates and breakaway wood posts, or Hinged Breakaway (HBA) Post™ may be specified for locations 3 and 4. Controlled Release Terminal (CRT) posts can be used for post locations 5 through 8.
4. Alternates to Note 3 combinations for locations 3 through 8 are: 1) All short tubes without soil plates and breakaway wood posts; 2) All HBA posts; 3) All CRT posts; 4) All SYTP

# ET-PLUS™

## 37'6" (11.43 m) System

FOR SPECIFIC DETAILS, REFER TO THE TRINITY ET  
DRAWING(S) AND STATE STANDARD DRAWING

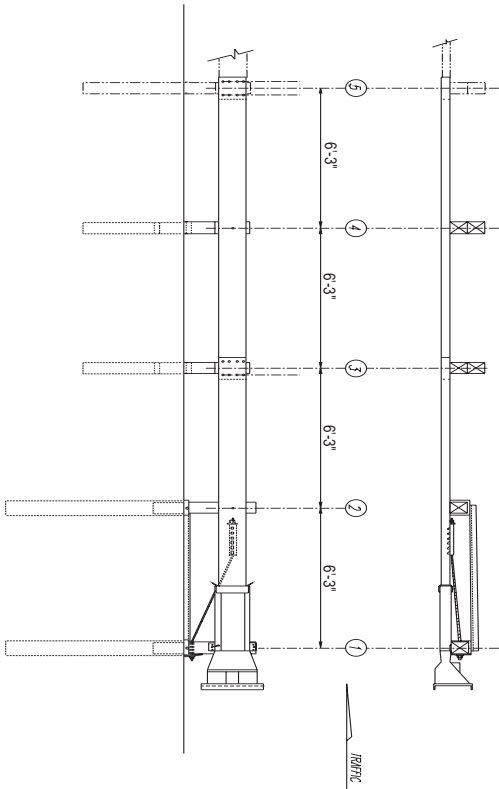


(This represents 1 version of the 37'6" (11.43 m) system)

### NOTES:

1. Alternate to long foundation tube without soil plate is short tube with soil plate at locations 1 and 2, Hinged Breakaway (HBA) Post™ at locations 1 and 2, or Hinged Breakaway (HBA) Post™ at location 1 and Steel Yielding Terminal Post™ (SYTP) at location 2; long foundation tube or short tube with soil plate at location 1 and SYTP at location 2.
2. Alternate to two 12'6" (3.81 m) long rail elements is one 25'0" (7.62 m) long rail element.
3. Short steel foundation tubes without soil plates and breakaway wood posts, or Hinged Breakaway (HBA) Post™ may be specified for locations 3 and 4. Controlled Release Terminal (CRT) posts can be used for post locations 5 through 7.
4. Alternates to Note 3 combinations for locations 3 through 7 are: 1) All short tubes without soil plates and breakaway wood posts; 2) All HBA posts; 3) All CRT posts; 4) All SYTP (SYTP required for first line post or location 8).

**ET-PLUS™ (TL-2)**  
**25'0" (7.62 m) System**  
 FOR SPECIFIC DETAILS, REFER TO THE TRINITY ET  
 DRAWING(S) AND STATE STANDARD DRAWING



(This represents 1 version of the 25'0" (7.62 m) system)

**NOTES:**

1. Alternate to long foundation tube without soil plate is short tube with soil plate at locations 1 and 2, Hinged Breakaway (HBA) Post™ at locations 1 and 2, or Hinged Breakaway (HBA) Post™ at location 1 and Steel Yielding Terminal Post™ (SYTP) at location 2; long foundation tube or short tube with soil plate at location 1 and SYTP at location 2.
2. Alternate to two 12'6" (3.81 m) long rail elements is one 25'0" (7.62 m) long rail element.
3. Short steel foundation tubes without soil plates, or Hinged Breakaway (HBA) Posts™ may be specified for locations 3 and 4.
4. Alternates to Note 3 combinations for locations 3 and 4 are: 1) All CRT posts; 2) All SYTP.

**ET-PLUS™ BILL OF MATERIAL**  
**ENGLISH (METRIC)**  
**(FOR QUANTITIES, SEE STATES OPTION(S))**

<b>PC</b>	<b>DESCRIPTION</b>
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 1/2" (50 STD. PIPE x 140)
740G	6" x 8" x 4'6" x 3/16" (152 x 203 x 1375 x 4.8) TUBE SLEEVE
742G	6" x 8" x 6'0" x 3/16" (152 x 203 x 1830 x 4.8) TUBE SLEEVE (ALTERNATE TO USING 740G AND 766G)
766G	18" x 24" x 1/4" (460 x 610 x 6) SOIL PLATE
782G	8" x 8" x 5/8" (200 x 200 x 16) BEARING PLATE
995G	GUARDRAIL EXTRUDER
3000G	CABLE ASSEMBLY 3/4" x 6'6" (19 x1981)
3300G	5/8" (16) WASHER
3340G	5/8" (16) HGR NUT
3360G	5/8"DIA. x 1 1/4" (16 DIA x 35) HGR SPLICE BOLTS
3478G	5/8" DIA. x 7 1/2" (16 DIA x 190) HEX HD BOLT
3497G	5/8" DIA. x 9 1/2" (16 DIA x 240) HEX HD BOLT
3500G	5/8" DIA. x 10" (16 DIA x 255) HGR POST BOLT
3580G	5/8" DIA. x 18" (16 DIA x 460) HGR POST BOLT
3700G	3/4" (19) WASHER
3701G	3/4" (19) WASHER
3704G	3/4" (19) HEX NUT
3717G	3/4 "x 2 1/2" (19 x 75) HIGH STRENGTH HEX HD BOLT
3718G	3/4" x 3" (19 x 75) HIGH STRENGTH HEX HD BOLT
3900G	1" (25) WASHER
3901G	1" (25) HEX NUT
4063B	WOOD POST - 6" x 8" x6'0" (150 x 200 x 1830)
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 1/2" x 7 1/2" x 3'9" (140 x 190x 1145)
4254G	3/8" (10) FLAT WASHER
4255G	3/8" (10) FENDER WASHER 1 1/2" OD (38)
4258G	3/8" (10) LOCKWASHER
4261G	3/8" DIA. x 1 1/2" (10 X 38) HEX HD BOLT
4228B	3/8" x 4" (10 x 100) LAG SCREW
4388G	7/16" (11) HEX NUT
4389G	7/16" (11) FLAT WASHER
4390G	7/16" DIA. x 1 1/2" (11 x 38) GR. 5 HEX HD BOLT
4393G	7/16" (11) LOCKWASHER
5148G	3/4" DIA. x 9 1/2" (19 DIA x 240) HS HEX HD BOLT
4699G	3/4" (19) LOCKWASHER BOLT @ POST 2
6321G	3/8" x 2' (10 x 50) HEX HD BOLT
6405G	3/8" (10) HEX NUT
6907B	POLYMER BLOCK 4" x 7 1/2" x 14" (100 x 187 x 350) [KING BLOCK]
9852A	STRUT
14578G	STEEL YIELDING TERMINAL POST (SYTP)

33871A ET HBA POST #1 TOP  
 33873A ET HBA POST #1 and #2 BOTTOM  
 33874A ET HBA POST #3 UP TO POST #8 BOTTOM  
 33877A ET HBA POST #2 UP TO POST #8 TOP  
 33875G 6'6" (1980) ANGLE STRUT  
 33795G 6'6" (1980) ANGLE STRUT  
 33730G 6'6" (1980) ANGLE STRUT

### **DELINEATION OPTIONS**

6206B RIGHT SIDE 1'1" x 2' 3 1/2" (325 x 700) REFLECTIVE SHEETING  
 6207B LEFT SIDE 1'1" x 2' 3 1/2" (325 x 700) REFLECTIVE SHEETING  
 6668B EITHER SIDE 12" x 12" (305 x 305) REFLECTIVE SHEETING

## **INSTALLING THE ET-PLUS™**

TrinityHighway Safety Products Inc. drawings for the ET-PLUS™ should be used in with these instructions.

The states standard drawings for this system need to be reviewed for details that will be specific to that state.

### **MATERIALS**

As packaged, the ET-PLUS™ system includes all materials needed for a complete installation. This will include either a 50'0" (15.24 m), 37'6" (11.43 m) or 25'0" (7.62 m) pay limit unless otherwise specified in the contract plans. Note that concrete footings or foundations are not required.

### **TOOLS REQUIRED**

Tools required are those ordinarily used to install standard highway guardrail (HGR). They include 9/16", 15/16", 1 1/4" and 1 1/2" sockets and wrenches and such other equipment as augers and post pounders commonly used in driving posts.

### **SITE PREPARATION**

When the guardrail is installed in-line with edge of the shoulder (without any offset), a 25:1 or flatter flare over the length of the system can be used to get the extruder head 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 Controlled Release Terminal (CRT) posts.

## **INSTALLATION OF THE ET ON A CURVE**

When an ET is terminated on a curve, the following should be used for the layout. For both conditions the ET must be straight over the length of the system. All offsets are measured to the face of the rail.

Outside of the Curve At the end of the line guardrail installation, which is following the curve of the roadway, the terminal end will be installed with the following offset from the curve that the guardrail is installed on:

ET: 50-foot long, 2 ft. max. offset.

ET: 37.5-foot long, 1.5 ft. max offset.

ET: 25-foot long, 1 ft. max. offset.

Inside of the Curve At the end of the line guardrail installation, which is following the curve of the roadway, the terminal end will be installed with the following offset from the curve that the guardrail is installed on:

For a curve radius of 1000 feet or less, the offset will be 1-foot maximum.

For a curve radius greater than 1000 feet, the offset will be as follows:

ET: 50-foot long, 2 ft. max. offset.

ET: 37.5-foot long, 1.5 ft. max offset.

ET: 25-foot long, 1 ft. max. offset.

## **INSTALLATION**

Be sure adequate time is allowed for "same day" complete installation.

If there are special field conditions encountered when installing the ET-PLUS™ System, contact Trinity Engineering @1-800-644-7976 to review the conditions.

## **POST INSTALLATION**

The following instructions are for the installation of the Control Release Terminal (CRT) posts or Steel Yielding Terminal Post (SYTP), foundation tubes with wood posts, Hinge Breakaway (HBA) posts™, and the SYTP.

## **INSTALLING THE CRT POSTS**

Install the wood posts (PC-4063B) at all locations where the tubes with or without soil plate are not used (See states standards). These posts may be driven. They may also be installed by drilling holes approximately 44" (1120 mm) deep. Insert the 6'0" (1830 mm) wood post into these holes and backfill. Note that in either case, the bottom of the upper 3 1/2" (90 mm) hole in the post is approximately at finished grade.

## **PLACING FOUNDATION TUBES/WOOD POSTS**

### **TUBE OPTIONS**

6'0" (1830 mm) Tube, no Soil Plate (Locations 1 & 2 only) No assembly required. Install the soil tube (PC-742G) as described below.

4'6" (1375 mm) Tube with Soil Plate (Locations 1 & 2 only) Assemble the soil tubes and soil plates. Bolt the soil plate (PC-766G) to the foundation tube (PC-740G) with two 5/8" x 7 1/2" (16 mm x 190 mm) hex head bolts (PC-3478G) and HGR nuts (no washers).

4'6" (1375 mm) Tube without Soil Plate (Location 3 through 8) No assembly required. Install the soil tube (PC-740G) as described below.

Install the foundation tubes at locations 1 and 2. Use the strut for a guide for the spacing of the tubes. Note: that the soil plate (if used) should be positioned on the downstream side of the post.

**DO NOT OVERTIGHTEN AND DEFORM THE TUBES  
DO NOT DRIVE TUBES WITH WOOD POST INSERTED**

## **INSTALLATION OPTIONS (Best preference listed first)**

### **METHOD A**

If the soil is permeable so water will drain from the tubes, the tubes may be driven with an approved driving head. The optimum depth will have the top of the tube 2 5/8" (67 mm) above the finished grade.

**For non-permeable soil:**

### **METHOD B**

Tube and Soil Plate drill a 12" (300 mm) pilot hole approximately 57" (1450 mm) deep and force the soil plate/tube assembly to the appropriate depth by impact or vibratory means with an approved driving head. The optimum depth will have the top of the tube 2 5/8" (67 mm) above the finished grade. Tube Only, drill a 12" (300 mm) pilot hole approximately 57" (1450 mm) or 75" (1905 mm) deep and place the tube to the appropriate depth. The optimum depth will have the top of the tube 2 5/8" (67 mm) above the finished grade.

### **METHOD C**

Same as method B, except the slots for the soil plates may be cut out by hand using a rock bar.

### **METHOD D**

Same as method B, except drill three adjacent 12" (300 mm) holes or one 24" (610 mm) hole to accommodate the soil plate/tube assembly. Extra care must be taken to prevent settlement or lateral displacement of the tubes.

If **METHOD D** is used, material should be placed in 6" (150 mm) lifts and compacted with pneumatic equipment to optimum compaction.

The finished guardrail height will generally be 27 3/4" (706 mm) above the edge of the shoulder or the finished grade. Site grading should be such that the tubes should not project more than 4" (100 mm) above the shoulder or finished grade.

## INSTALLING HBA BOTTOM POSTS

The posts should be oriented so that the large hole (13/16" [21 mm]) is placed downstream (away from the impact end of the system).

Because of the extruder head, the rail panel is pushed away from post 2. The rail panel should be within 1/2 inch of post 2, so the offset to post 2 needs to be adjusted.

### **METHOD A**

Drive the HBA Bottom Posts (PC-33873A, PC-33874A) with an approved driving head to the appropriate depths, approximately 72" (1830 mm) for post PC-33873A and 44" (1120 mm) for post PC-33874A. The optimum depth will have the bottom of the 13/16" (21 mm) hole in the ears even with the finished grade.

### **METHOD B**

For HBA Bottom Posts (PC-33873A), drill a 12" (300 mm) pilot hole approximately 72" (1830 mm) deep and force the posts to the appropriate depth by impact or vibratory means with an approved driving head. For HBA Bottom Posts (PC-33874A), drill a 12" (300 mm) pilot hole approximately 44" (1120 mm) deep and force the posts to the appropriate depth by impact or vibratory means with an approved driving head. The optimum depth will have the bottom of the 13/16" (21 mm) hole in the ears even with the finished grade.

If **METHOD B** is used, material should be placed in 6" (150 mm) lifts and compacted with pneumatic equipment to optimum compaction.

**NOTE: The HBA Post can be driven with the top HBA Post attached. The top HBA post should be attached per the "INSTALLING HBA TOP POSTS" section.**

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

If rock is encountered when installing the tube(s), HBA post(s), or SYTP(s) use the following procedures, unless there is a more restrictive state specification.

If rock is encountered and 20" (510 mm) or less depth is required to complete the installation of the full tube, bottom HBA post, or SYTP, drill a 12"-16" (300 mm - 400 mm) diameter hole in the rock. The hole should be drilled 2" (50 mm) deeper than required embedment depth. Place in the bottom 2 inches (50 mm) of the hole for drainage granular material or small pieces of the drilled rock. Backfill and compact the hole after installing the tube, HBA post, or SYTP. If compactable, the material removed from the hole may be used for the backfill.

If rock is encounter and more than 20" (510 mm) depth is required to install the full tube, bottom HBA post, or SYTP, drill a 12"-16" (300 mm-400 mm) diameter hole 22" inches (560 mm) deep into the rock. Install the tube, HBA post, or the SYTP in the hole. Cut off the embedded portion so the guardrail will be installed at the proper mounting height. Place in the bottom 2 inches (50 mm) of the hole for drainage granular material or small pieces of the drilled rock. Backfill and compact the hole after installing the tube, HBA post, or SYTP. If compactable, the material removed from the hole may be used for the backfill.

## INSTALLING WOOD POSTS IN TUBES



Insert pipe sleeve (PC-705G) in post (PC-4147B) and install in steel tube at location 1.



Install wood post(s) (PC-4147B) in tubes at the following location(s) per the states requirements:

- 2 only
- 2 through 4
- 2 through 7
- 2 through 8

At locations 3 through 8, when used, a 5/8" x 9 1/2" (16mm x 240mm) hex bolt and 5/8" (16mm) nut are used to secure the wood post to the foundation tube. The bolt should be installed from the embankment side.

**DO NOT OVERTIGHTEN THE BOLTS AND DEFORM THE TUBES.**

## INSTALLING THE SYTP IN TUBES

Install the SYTP(s) in tubes at the following location(s) per the states requirements.

- 2 only
- 2 through 4
- 2 through 7
- 2 through 8

At location 2, follow the instructions in the "Installing the strut" section

At locations 3 through 8, when used, a 5/8" x 9 1/2" (16mm x 240mm) hex head bolt and 5/8" (16mm) nut are used to secure the SYTP to the tube. The bolt should be installed from the embankment side. The bolt will go through a spacer (PC-4161B) that is installed between the back of the SYTP and the tube.

**DO NOT OVERTIGHTENED THE BOLTS AND DEFORM THE TUBES.**

## INSTALLING HBA TOP POSTS

Once the bottom posts are installed, the upper posts can be installed.

The post plates (ears) can be installed on either side of the bottom post plates (ears).

At Post No. 1, install the upper posts (PC-33871A) by aligning the holes of the ears on the upper and lower posts. In the 7/16" (11 mm) inch holes, install a 3/8" (10 mm) diameter x 2" (50 mm) hex head bolt with a 3/8" (10 mm) washer, 3/8" (10 mm) lock washer under the 3/8" (10 mm) hex nut (PC-6405G). The bolts can be installed so the nuts are on the inside or outside the ears. **See Figure 1.** In the 13/16" (21 mm) holes opposite the strut side, install a 3/4" (19 mm) diameter x 2 1/2" (63 mm) hex head high strength bolt (PC-3717G) with a 3/4" (19 mm) washer (PC-3701G), 3/4" (19 mm) lock washer (PC-4699G) under the 3/4" (19 mm) hex nut (PC-3704G). The bolts can be installed so the nuts are on the inside or outside the ears. There is no torque requirement for these bolts. They should be tightened to a snug position.

**DO NOT INSTALL THE 3/4" (19 MM) BOLT ON THE STRUT SIDE UNTIL THE STRUT IS READY TO BE INSTALLED.**

At post No. 2, install the upper post (PC-33877A) by aligning the holes of the ears on the upper and lower posts. In the 7/16" (11 mm) holes, install a 3/8" (10 mm) diameter x 2" (50 mm) hex head high strength bolt with a 3/8" (10 mm) washer, 3/8" (10 mm) lock washer under the 3/8" (10 mm) hex nut. For the bolt opposite the strut, install it so the nut is on either side of the ears. For the 3/8" (10 mm) bolt that is on the side of the strut, install the bolt through the ears with the bolt head on the same side as the strut. In the 13/16" (21 mm) hole opposite the strut side, install a 3/4" (19 mm) diameter x 2 1/2" (63 mm) hex head high strength bolt with a 3/4" (19 mm) washer, 3/4" (19 mm) lock washer under the 3/4" (19 mm) hex nut. The bolt can be installed so the nut is on either side of the ears. **See Figure 2.** There is no torque requirement for these bolts. They should be tightened to a snug position.

**DO NOT INSTALL THE 3/4" (19 MM) BOLT ON THE STRUT SIDE UNTIL THE STRUT IS READY TO BE INSTALLED.**

At post No. 3 thru 8, where Hinged Breakaway™ (HBA) posts are used, install the upper post (PC-33877A) by aligning the holes of the ears on the upper and lower posts. In the 7/16" (11 mm) holes, install a 3/8" (10 mm) diameter x 2" (50 mm) hex head high strength bolt (PC-6321G) with a 3/8" (10 mm) washer (PC-4254G), 3/8" (10 mm) lock washer (PC-4258G) under the 3/8" (10 mm) hex nut (PC-6405G).

The bolts can be installed so the nuts are on either side of the ears. In the 13/16" (21 mm) holes, install a 3/4" (19 mm) diameter x 2 1/2" (63 mm) hex head high strength bolt with a 3/4" (19 mm) washer, 3/4" (19 mm) lock washer under the 3/4" (19 mm) hex nut. There is no torque requirement for these bolts. They should be tightened to a snug position.

## **INSTALLING THE SYTP**

The SYTP can be driven or installed in a tube. It can be installed at all locations except a location 1. The tube options and installation of the tubes are the same as for the CRT Posts.

The SYTP(PC-14578G) that is driven is 6'-0" long. The SYTP (PC-14329G) installed in a tube is 42 5/8" inches long.

The SYTP has four (4) 1/2" diameter holes through the flange that the center of the holes will be at the ground line when driven. When they are installed in a tube, the center of the holes will be at the top of the tube.

## **INSTALLING THE STRUT**

### **WITH SOIL TUBES**

Place the angle ground strut (PC-33875G) on the embankment side of the foundation tubes. A 3/4" (19 mm) diameter x 9 1/2" (240 mm) hex head high strength bolt is used to attach the strut to the foundation tube, and should be installed from the embankment side. A washer is placed between the bolt head and the strut and the nut and the foundation tube.

An alternate to the angle strut is the channel ground strut (PC-9852A). Place the slotted yokes of the ground strut over the foundation tubes at posts 1 and 2. A 5/8" (16 mm) diameter x 9 1/2" (240 mm) hex head bolt is used to attach the strut to the foundation tube. Note that the bolt goes through the strut, the foundation tube, and the wood post and should be installed from the embankment side. A washer is placed between the bolt head and the strut and the nut and the strut.

### **DO NOT OVERTIGHTEN THE BOLTS AND DEFORM THE TUBES.**

### **WITH SOIL TUBE/SYTP**

Place the angel ground strut (PC-33875 or PC-33795) on the embankment side of the tube and SYTP. PC-33795G is used with the driven SYTP. PC-33875G is used with the SYTP in a tube. The strut can be placed with one of the legs flat on the ground or with the leg edge on the ground.

**POST LOCATION 1** A 3/4" (19 mm) diameter x 9 1/2" (240 mm) hex head high strength bolt is used to attach the strut to the foundation tube, and should be installed from the embankment side. The bolt should pass through the strut, the tube, and the wood post. A washer is placed between the bolt head and the strut and the nut and the foundation tube.

**POST LOCATION 2 (Driven SYTP)** In the slotted holes of the strut and the 1/2" (13 mm) diameter holes of the SYTP, place a 7/16" (11 mm) diameter x 1 1/2" (38 mm) hex head high strength bolt. Place a 7/16" (11 mm) flat washer between the bolt head and the strut. A 7/16" (11 mm) lock washer is placed under the 7/16" (11 mm) hex nut.

**POST LOCATION 2 (SYTP IN TUBE)** A 3/4" (19) diameter x 9 1/2" (240 mm) hex head, high strength bolt is used to attach the strut to the tube, and should be installed from the embankment side. The bolt should pass through the strut, the tube, the spacer, the SYTP and the tube again. A washer is placed between the bolt head and the strut and the nut and the tube.

**There is no torque requirement for these bolts. They should be tightened to a snug position.**

An alternate to the angle strut is the channel ground strut (PC-9852A). Place the slotted yokes of the ground strut over the tubes at locations 1 and 2. See "INSTALLING THE STRUT WITH TUBES" sections for the installation at location 1. A 5/8" (16 mm) diameter x 9 1/2" (240 mm) hex head bolt is used to attach the strut to the tube. The bolt goes through the strut, the tube, the spacer, the SYTP and should be installed from the embankment side. A washer is placed between the bolt head and the strut and the nut and the strut.

**There is no torque requirement for these bolts. They should be tightened to a snug position.**

**DO NOT OVERTIGHTEN THE BOLTS AND DEFORM THE TUBES.**

**WITH HBA POSTS/SYTP**

Place the angle ground strut (PC-33875G or PC-33795G) on the embankment side of the HBA posts or the SYTP. PC-33795G is used with the SYTP. The strut can be placed with one of the legs flat on the ground or with the leg edge on the ground.

**POST LOCATION 1** In the 13/16" (21 mm) hole of the HBA Post No. 1 post plates, install a 3/4" (19 mm) diameter x 2 1/2" (63 mm) hex head high strength bolt. The bolt is placed through the two post plates and through the strut. A 3/4" (19 mm) washer, and a 3/4" (19 mm) lock washer are placed under the 3/4" (19 mm) hex nut.

**POST LOCATION 2 HBA POST** In the 13/16" (21 mm) holes of the HBA Post No. 2 post plates, install a 3/4" (19 mm) diameter x 3" (75 mm) hex head high strength bolt. The bolt is placed through the two post

plates and through the strut. A ¾" (19 mm) washer and ¾" (19 mm) lock washer are placed under the ¾" (19 mm) hex nut. Two to three washers are stacked on the bolt between the strut and the post plate to allow the strut to pass over the 3/8" (10 mm) bolt head.

**POST LOCATION 2 DRIVEN SYTP** In the slotted holes of the strut and the ½" (13 mm) diameter holes of the SYTP, place a 7/16" x 1 ½" (11 mm x 38 mm) high strength hex head bolt. Place a 7/16" (11 mm) flat washer between the bolt head and the strut. A 7/16" (11 mm) lock washer is placed under the 7/16" (11 mm) hex nut.

**POST LOCATION 2 SYTP IN TUBE** Follow the installation instructions in "TUBE/SYTP, POST LOCATION 2 SYTP IN TUBE" section.

**There is no torque requirement for these bolts. They should be tightened to a snug position.**

**DO NOT OVERTIGHTEN THE BOLTS AND DEFORM THE TUBES.**

## **INSTALLING OFFSET BLOCKS AND RAIL PANELS**

The ET-PLUS system uses 25'0" (7.62 m) rail panels, PC-60G and PC-62G or 12'6" (3.81 m) rail panels, PC-9G and PC-32G. The states standards should be reviewed for what system to use.

The rail panels are spliced together with eight (8) 5/8" x 1 ¼" (16 mm x 32 mm) splice bolts and hex nuts.

The terminal rail should be lapped in the direction of traffic unless the agency's policy dictates otherwise.

Do not bolt the rail panel to the post at location 1 and the HBA post at location 2.

**Offset blocks are not used at post locations 1 and 2. They are used at all other locations.**

### **INSTALLING RAIL PANEL TO POST WITH OFFSET BLOCK**

For wood posts, the wood offset block and the rail panel are bolted to the post using a 5/8" (16mm) diameter x 18" (460 mm) post bolts, a hex nut, and a round washer. The washer is installed between the wood post and the nut. The wood offset block should be secured to prevent it from rotating. This can be done by toe nailing the block to the post or the post to the block using 16d hot-dipped galvanized nails.. Nails should be installed approximately 3" (75mm) from the top of the post or block, one on each side.

For the HBA post and SYTP, the rail panel and routed offset block are bolted to the post using a 5/8" (16 mm) diameter x 10" (255 mm) post bolt, a hex nut and a round washer. The washer is installed between the post and nut. There are two (2) sets of holes in the SYTP for attaching the rail. Use the hole that will place the rail to the correct height.

## **INSTALLING RAIL PANEL TO POST WITHOUT OFFSET BLOCK**

For the wood post at Location 2, bolt the rail element to the wood post using a 5/8" (16 mm) diameter x 10" (255 mm) post bolt, a hex nut, and a round washer. The washer is installed between the wood post and the nut.

For the SYTP at Location 2, bolt the rail element to the post using a 5/8" (16 mm) diameter x 1 1/4" (31 mm) H.G.R. bolt, a hex nut, and a round washer. The washer is installed between the post and the nut. There are two (2) sets of holes in the SYTP for attaching the rail. Use the hole that will place the rail to the correct height.

## **INSTALLING THE CABLE ANCHOR ASSEMBLY**

The cable anchor bracket (PC-704A) is secured to the rail panel by inserting the protruding hooks on the bracket into the slots in the rail panel. It is locked into place by pulling the bracket towards the impact end of the unit.

Slide one end of the cable (PC-3000G) into the cable anchor bracket and the other end through the sleeve in post 1. Place a 1" (25 mm) washer on the end of the cable that extends through the cable anchor bracket. Place the bearing plate (PC-782G) with the 5" (125 mm) dimension up and the 3" (75 mm) dimension down. When a wood post is used at location 1, the bearing plate is prevented from rotating by driving two nails along its top edge and bending them over.

Secure each end of the cable with a 1" (25 mm) hex nut and tighten. Restrain the cable with vise grips pliers at the end being tightened to avoid twisting the cable. Make sure the nuts are tight and the cable is taut.

## **INSTALLING THE GUARDRAIL EXTRUDER HEAD**

The final piece to attach is the guardrail extruder head (PC-995A). Place the extruder head over the end of the rail panel. The extruder head can be used on the left or right hand shoulder. Be sure the exit slot is on the back side, away from traffic.

The extruder head should be pushed on the rail panel as far as it will go. The extruder tail should be installed approximately parallel to the ground. The attachment brackets have 3 holes in each bracket to provide tolerance in the installation.

The extruder head is installed to the wood post with one 3/8" (10 mm) diameter x 4" (100 mm) lag screw in the top and bottom bracket. Choose the hole in the bracket that is closest to the center of the post. Drill a 1/4" (6 mm) pilot hole to avoid breaking the lag screw during installation. The lag screw must be screwed into the post to prevent it from pulling out or cracking the post.

The extruder head is installed to the HBA post with a 3/8" (10 mm) diameter x 1 1/2" (38 mm) hex head bolt, washer, fender washer and bolt. Place the fender washer between post flange and the nut.

### **DELINEATION OPTION FOR THE ET- PLUS™**

High intensity reflective sheeting (PC-6206B [Right Side] or PC-6207B [Left Side]) is installed on the front face of the extruder head. Alternate reflective sheeting is PC-6668B. It requires two pieces and should be rotated for proper delineation. The reflective sheeting is an option to the ET-PLUS™ and needs to be ordered separate from the ET-PLUS™ package.

## ET- PLUS™ INSTALLATION CHECK LIST

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

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

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

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

- The rail height is in accordance with the plans (generally 27 3/4" [706 mm] above the edge of the shoulder or the finished grade). The height to the bolt hole should be 1' 9 5/8" (550 mm).
- The steel tubes or ears to the bottom HBA posts do not protrude more than 4" (100mm) above the finished grade measured by the AASHTO 5" (1.5 m) cord method. Site grading may be necessary to meet this requirement.
- The bolts connecting the tops of the HBA posts to the bottoms of the HBA posts are not loose.
- The bolts at the top of the steel tubes are not over tightened and collapsing the walls of the steel tubes.
- The bolts connecting the angle ground strut are HIGH STRENGTH.
- The end of the guardrail is butted up to the beginning of the bending slot in the extruder head.
- The two lag bolts holding the extruder head to post 1 are snug and the extruder tail is approximately parallel to the finished grade.
- The 8" x 8" (200 mm x 200 mm) bearing plate at post 1 is correctly positioned (5" [125 mm] up and 3" [75 mm] down) and the anchor cable is taut and correctly installed (it should be rechecked after installation to be sure it hasn't relaxed).
- Wood offset blocks have been toe nailed to the posts.
- The backfill material around the posts is properly compacted. Each HBA post has two bolts on either side of the post and should be oriented so that the larger bolt is downstream of the smaller bolt.
- The center of the SYTP holes is at the ground line.
- The Controlled Released Terminal (CRT) post has two 3 1/2" (90 mm) breakaway holes (checked prior to installation). They should be located parallel to the roadway with the bottom of 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.

# MAINTENANCE/ REPAIR INSTRUCTIONS FOR ET- PLUS™ GUARDRAIL END TERMINAL

## MAINTENANCE

Maintenance consists of periodically checking the system to see that the cable is taut, the nuts have not been removed from the cable, and the blockouts have not rotated.

## REPAIR

1. At the accident site, setup necessary traffic control and then remove any debris that has encroached onto the traveled way or shoulder. Install any necessary delineation necessary for the damaged system. Take inventory of the damaged system and determine what parts are reusable and what parts need to be replaced. Check the extruder head for damage. It is normally reusable. Check the anchor cable and bracket for damage. The bearing plate, nuts and washers, and anchor bracket are rarely damaged.
2. Obtain those parts that need to be replaced.
3. With the replacement parts, return to the repair site.
4. Burn off the extruded rail near the extruder head. Secure a chain to the extruder head and pull it off the rail with the chain attached to a truck frame while the other end of the rail is still connected to the downstream posts to provide anchorage.
5. Remove any damaged rail that has to be replaced.
6. Remove the broken posts in the steel tubes using one of the two post removal tools that can be assembled from "off the shelf hardware" items (See page 19). Pound the steel pipe or screw the lag screws into the top of the broken post and remove the broken post by pulling on the chain. If necessary, place a steel rock bar in the loop of the chain and use it as a lever arm to remove the post.
7. Remove any damaged Controlled Release Terminal (CRT) posts.
8. After the site has been cleared of damaged debris, the system can be reconstructed following the installation instructions.

**Note: If rubber bumpers or construction legs are encountered on damaged ET-2000™ systems, they are to be removed and discarded.**

## **EQUIPMENT NEEDED FOR REPAIR OPERATION**

- (1) Acetylene torch to cut off extruded rail.
- (2) Heavy duty chain to remove the extruder head.
- (3) S.A.E. wrench or socket sizes 9/16", 15/16", 1 1/4", and 1 1/2".
- (4) Vice grip or channel lock pliers and sledge hammer.
- (5) Post removal tool and other normal guardrail tools.
- (6) Vehicle to pull the extruder off from the damaged rail.