Installation and Maintenance Manual

X-TENSION GUARDRAIL TERMINAL END

Revolutionary Tension-Based Technology

“Advancing Safety Through Innovation”
PREFACE

The Barrier Systems, Inc. (BSI) X-Tension Guardrail Terminal End system incorporates the newest roadside safety materials and engineering processes.

As with any roadside safety device, the X-Tension Guardrail Terminal End system must be installed properly to ensure proper performance. Thoroughly review and fully understand the installation instructions and product limitations before starting the installation. Do not start the installation without the proper plans and tools required.

If you need additional information, or have questions about the X-Tension Guardrail Terminal End, please call the BSI Customer Service Department at (888) 800-3691 (U.S. toll free) or (707) 374-6800.

Introduction

The X-Tension Guardrail Terminal End has been designed and tested to meet the evaluation criteria of NCHRP 350 Test Level 3.

The system has been tested to the guidelines in NCHRP 350 for a non-gating, re-directive guardrail terminal end. When correctly installed and maintained, the system is capable of stopping, containing, or redirecting an errant vehicle in a safe manner under NCHRP 350 impact conditions.

The X-Tension Guardrail Terminal End is the world’s first fully redirective, non-gating guardrail terminal end. The unique X-Tension technology is a tension-based solution rather than compression-based. It offers exceptional vehicle control.
and energy absorbing capabilities in head-on collisions, where energy is absorbed with re-
sistance at the impact head rather than being transferred down the rail as occurs with other systems. Even head-on high-angle (15° dur-
ing testing) impacts on the nose resulted in the vehicle being redirected and controlled rather 

than passing to the backside of the terminal at high speed.

SYSTEM OVERVIEW

The X-Tension Guardrail Terminal End system is
designed and constructed to provide acceptable structural adequacy, minimal occupant risk and 
safe vehicle trajectory as set forth in NCHRP 

350 for guardrail terminal ends.

When impacted head-on with an 1,800 to 4,400 

lb. (820 to 2,000 kg.) vehicle at speeds of up 
to 62 mph (100 km/h), the impacting vehicle is 
brought to a controlled stop or allowed to pen-

etrate to the back side, depending on the impact 

conditions.

REQUIRED TOOLS

Use standard system installation tools.

BEFORE INSTALLING THE X-TENSION GUARDRAIL TERMINAL END SYSTEM

Placement and use of the X-Tension Guardrail 

Terminal End system should be accomplished 
in accordance with the guidelines and recom-

mendations set forth in the “AASHTO Roadside 

Design Guide,” FHWA memoranda and other 

state and local standards.

Depending on the application and circumstances 
at the job site, installation and assembly of a 

Test Level 3 system should take a two-person 

crew less than 2 hours.

The X-Tension Guardrail Terminal End system 
is a highly engineered safety device made up of 

a relatively small amount of parts. Before start-
ing the assembly, become familiar with the basic 

elements that make up the system.

LIMITATIONS AND WARNINGS

The X-Tension Guardrail Terminal End system 

has been rigorously tested and evaluated per 

the recommendations in the NCHRP Report 350 
guidelines for terminals and crash cushions. 
The impact conditions recommended in NCHRP 

350 are intended to address typical in-service 
collisions.

When properly installed and maintained, the 

system is capable of containing and redirect-
ing impacting vehicles in a predictable and safe 
manner under the NCHRP 350 impact condi-

tions.

Vehicle impacts that vary from the NCHRP 

350 impact conditions described for guardrail 
terminal ends may result in significantly differ-

ent results than those experienced in testing.
Vehicle impact characteristics different than or in excess of those encountered in NCHRP 350 testing (speed and angle) may result in system performance that may not meet the NCHRP 350 evaluation criteria.

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Preparing for Installation

This manual shows the components and procedures required to install the X-Tension Guardrail Terminal End system. This is a tangent terminal with a maximum flare rate of 16 in (400mm) over the 38 ft (11.4m) length.

Ensure that the area where the system is to be installed is flat enough so that the soil anchor will not protrude more than 4 in (100mm) from ground level, when measured with a straight line over a 5 ft (1500mm) cord. Minor site grading may be required.

Begin the installation from the downstream end of the terminal at the point where it joins the standard guardrails (Post 7).

Key steps in the installation are:
1. Install Posts 3 through to 6 (steel or timber breakaway posts)
2. Install Post 1 bottom and top and soil anchor/ground strut
3. Install Rail 3 and 2
4. Assemble Slider on Rail 1
5. Install Rail 1
6. Attach Head
7. Install Cables
8. Attach Plastic Nosepiece

SYSTEM INSTALLATION

Step 1: Install Posts 3 - 6
These 4 posts are either standard steel wide flange posts or CRT Timber Posts. Posts may be driven, or in stiff soils a 6 in (150mm) diameter hole can be drilled and the post rammed into the hole. The post may also be placed in an oversized augured hole, but care must be taken to ensure the backfill is properly compacted.

Hint: Offset Post 3 backward 1.5 - 2 in (40-50mm) to make it easier to push Rail 1 & slider over Rail 2. (Cont.)
Step 1: Install Posts 2 - 6 (Cont.)

Note: If you are installing steel posts, use the wide flange post provided. If you are installing timber line posts, Post 2 can be a standard CRT timber post like posts 3-6.

When driving steel posts, ensure that a driving cap with timber or plastic insert is used to prevent damage to the galvanizing on the top of the posts.

Bolt the block out to the post at Post 3.

Step 2: Install Post 1 and Anchor Post

Ram or auger in the Post 1 bottom half so that no more than 100mm protrudes above ground level. Use the ground strut as a template to place the anchor point in the correct place. Ram or drill the anchor point in. Bolt the ground strut into place with Post 1 top placed in the Post 1 bottom. Use M16 x 180mm hex head bolt. Do not over tighten bolt.
Step 3: Install Rail 3 & Cable Anchor Bracket
This rail is installed in the same manner as standard guardrail with Post 6 being in the center of the rail. Before splicing the rail on, attach the cable anchor bracket to the back of the rail at the joint between Rail 3 and Rail 4 (Post 7) as one would a standard BCT bracket. Bolt Rail 3 to the post and blockouts at Post 7 and 6. Splice Rail 3 to Rail 4 with the 8 splice bolts supplied. Rail 4 is standard guardrail system.

Step 4: Install Rail 2
Before installing Rail 2, double check that the blockout is bolted to Post 3. This rail is installed the same as standard guardrail with Post 4 being in the center of the rail. Splice Rail 2 to Rail 3 with the 8 special sheer bolts (supplied.) **Put the washer on the nut side of the rail if using metric hardware (standard U.S. hardware uses guardrail nut.)**

**DO NOT USE STANDARD SPLICE BOLTS.**

Bolt Rail 2 to the post and blockouts at Post 4 and 5, but NOT at Post 3.
Step 5: Fix Slider Bracket to Rail 2
Bolt the slider bracket to the end of Rail 2 that joins Rail 1 (Post 3). Use 4 splice bolts.

The angle bar end should be closest to the impact head end.

Remove the angle bar and 2 M20 bolts.

Note: Rail is NOT bolted to the blockout or post at Post 3.

Step 6: Assemble Slider on Rail 1
Start by sitting Rail 1 on a blockout or post so that it is raised off the ground as shown.

Slide the slider panel onto the downstream end of rail and bolt into place using 4 splice bolts, pushing the bolt through from the inside of the slider panel to the outside so that the nut is on the traffic side.
**Step 7: Install Rail 1**
Lift Rail 1 with the slider attached and push the slider over Rail 2. Overlap the rails as per a standard splice join overlap.

Bolt Rail 1 and blockout to Post 2 using bolts supplied.

Re-attach the angle bar to the slider bracket on the backside of the rail.

**Step 8: Attach Impact Head**
Place impact head on upstream end of Rail 1 and attach using 8 standard splice bolts with nuts on the traffic side.

Bolt head and Rail 1 to Post 1 using 50mm splice bolt supplied. Use 50x50mm washer under nut on the inside of Post 1.
**Step 9: Place the Cables**

Push the cables under the steel strap on the ground strut and forward through the holes at the top of the anchor post. Lay the cables out parallel to the guardrail, downstream from the anchor post.

Ensure that the bottom cable (closest to road) has half the thread protruding through the anchor post, as shown.

Ensure the top cable has just the nut wound a few turns past the end of the thread.

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**Step 10: Installing the Cables**

Taking the cable closest to the road, pick up the far end threaded cable fitting and walk to the head, passing the cable through the bottom hole, through the locking bar and out the backside of the impact head.

Pull from the back side until cable is pulled through the impact head. (Cont.)
Step 10: Installing the Cables (Cont.)
Repeat this process with the other cable but take it through the top hole.

At this stage, the cables are threaded through the impact head and lying on the ground on the back side of the impact head.

Take each cable down its respective trough in the back of the W-beam and attach to the cable bracket at Post 7.

Do not tighten the cables at this time.

Step 11: Turning the Locking Bar
Put a pry bar through the hole at the top of the locking bar and turn it counter-clockwise.

Using a socket, tighten the 4 setting bolts on the side of the impact head to lock the bar in the turned position.
Step 12: Tightening the Cables
Once the locking bar is turned, the cables may be tightened.

Only tighten the cables using the nuts at the cable bracket end (Post 7). Do not tighten the cable nuts at the front of the ground anchor.

Tighten the cables until they are taut, i.e. they rest in the backside of the W-beam and do not visibly sag between posts.

Note: There is NO torque requirement for the cables.

Step 13: Install Plastic Nose Piece
Push the Nose Piece into place on the front of the impact head as shown. Secure using a nylon push-in tree connector.
## INSTALLATION CHECKLIST FOR X-Tension Guardrail Terminal End (System Length 11.4m)

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| End (first) Rail is bolted to post #1 and all others except post 3 |
| Post #1, steel breakaway, up right way and bolted at base. |
| Steel or Timber breakaway posts installed from Post 2 through 6. |
| Rail is set at 550mm to centre of rail. |
| Locking Bar is turned fully and bolted in place. |
| Nuts are fitted on traffic face of rail at impact head. |
| Correct nosing is fitted to impact head. |

| Ground strut lays flush with ground. Ground Anchor should be lower than post #1. |
| Ground anchor does not protrude more than 100mm above the ground. |
| The entire Terminal End (11.4m rail) is installed straight with flare as per design (offset between 0 mm to 400 mm) |

| Slider is connected to end of first rail. All 4 outer holes bolted with nuts on traffic face. |
| Slider bracket and angle bar are attached correctly. Angle bar closest to impact head end. |
| Guardrail for terminal end (i.e. 3 lengths) must be 2.7mm highway rail. |
| Yellow Shear Bolts correctly installed at post 5 (washer only between nut and rail. |
| Cables are taut, i.e. – not visibly sagging between posts. |
### SIDE IMPACTS

**Key Repair Steps:**

1. Remove cables
2. Remove damaged rail
3. Remove components from rails
4. Remove damaged posts
5. Reassemble

**Step 1: Remove Cables**
Undo the nuts at the downstream cable bracket (Post 7). Take out the bolts on the side of the impact head that hold the locking bar in place. Rotate the locking bar backwards until it stops. Pull one cable at a time from the front side of the impact head and completely remove them. Rotating the cables as you pull them will help. Undo the nuts at the ground anchor end and remove the cables.

**Step 2: Remove Rails**
First unbolt the splice bolts. Then unbolt the post bolts and lower the rails to the ground.

**Step 3: Remove X-Tension Components**
All of the X-Tension components are attached to the rails with standard splice bolts. Unbolt and remove the components.

**Step 4: Remove Posts**
Undo the bolt at the bottom of Post 1 and remove post. For all other line posts, attach a chain to the top half of the post and pull the post out of the ground with either a HIAB crane or digger. Note: it is sometimes possible to remove the posts by hand.

(Continued)

### HEAD-ON IMPACTS

**Key Repair Steps:**

1. Remove cables
2. Pull rails back
3. Remove components from rails
4. Remove damaged posts
5. Reassemble

**Step 1: Remove Cables**
Undo the nuts at the downstream cable bracket (Post 7). Take out the bolts on the side of the impact head that hold the locking bar in place. Rotate the locking bar backwards until it stops. Pull one cable at a time from the front side of the impact head and completely remove them. Rotating the cables as you pull them will help. Undo the nuts at the ground anchor end and remove the cables.

After a head-on impact, the cables can appear to be slack on the ground, but they may still retain some tension from the impact. Care must be taken when removing the cables. **DO NOT UNDO THE CABLES FROM THE GROUND ANCHOR END FIRST.** Always undo the cables from the cable bracket first to release any tension.

**Step 2: Pull Rails Back**
Attach a chain or two ton strap to the front of the impact head and use a light truck or utility vehicle to pull the rails upstream to their original position. The components are easier to unbolt when the rails are separated rather than telescoped.

(Continued)
**SIDE IMPACTS (Cont.)**

**Step 5: Assess the Damage**
Panels with limited damage can be straightened with a hammer or mallet and reused. Any part that cannot be reused must be replaced with a new part. Always replace the cables and any damaged posts. Generally, all the specialized components of the system (head, brackets, etc.) should be undamaged.

**Step 6: Reassemble**
Reassemble as per system installation instructions.

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**HEAD-ON IMPACTS (Cont.)**

**Step 3: Remove X-Tension Components**
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