

CAT[®]-350
Crash Cushion
Attenuating Terminal

Assembly Manual

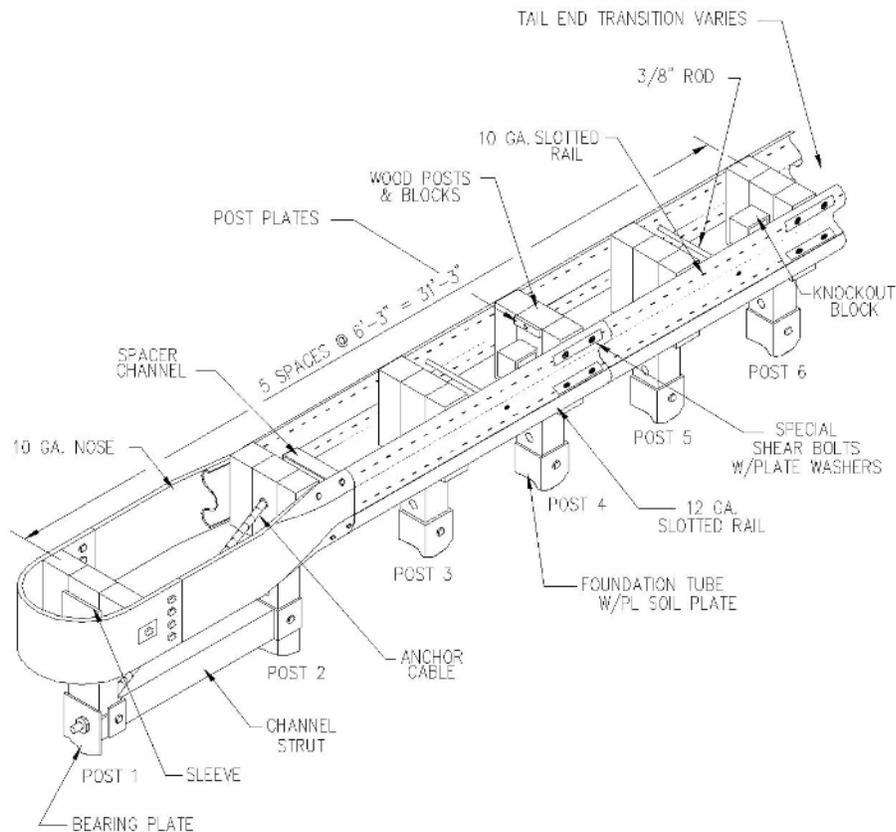
Part No. 620291B

Revised February 2005



TRINITY
HIGHWAY PRODUCTS
ENERGY ABSORPTION SYSTEMS

**FOR SPECIFIC DETAILS, REFER TO THE CAT-350™
DRAWING(S) AND
THE STATE STANDARD DRAWING(S)**



CAT-350™

(This represents the CAT-350™ system with 6 short tubes with soil plates)

NOTES:

Alternates to the 6 short tubes with soil plates are:

1. Six (6) long tubes with no soil plates.
2. Any combination of long tubes and short tubes with soil plates
3. Two (2) long tubes at Posts 1 and 2 and four (4) CRT posts at Posts 3 through 6.
4. Two (2) short tubes with soil plates at Posts 1 and 2 and four (4) CRT posts at Posts 3 through 6.

Alternate to the channel strut is the angle strut.

CAT- 350™ BILL OF MATERIAL
ENGLISH (METRIC)
(FOR SPECIFIC MATERIALS AND QUANTITIES, SEE STATE'S OPTION(S))

PN	QTY	DESCRIPTION
31G	2	12/12.5' (2.67/3.81) CAT (GUARDRAIL)
130A	2	10/12.5"/5'10:6'8/SP (3.43/3810/SP) CAT (GUARDRAIL)
705G	1	PIPE SLEEVE - 2" STD PIPE x 5 1/2" (50 STD PIPE x 140)
740G	V	6" x 8" x 4'6" x 3/16" (152 x 203 x 1375 x 4.8) TUBE SLEEVE
749G	V	6" x 8" x 6'0" x 3/16" (152 x 203 x 1830 x 4.8) TUBE SLEEVE (ALTERNATE TO USING 740G AND 769G)
769G	V	18" x 24" x 1/4" (460 x 610 x 6) SOIL PLATE
782G	1	8" x 8" x 5/8" (200 x 200 x 16) BEARING PLATE
983G	1	10 (3.43)/NOSE PLATE/ CAT/ ROLLED
984G	2	10 (3.43)/SIDE PLATE CAT
3012G	1	CABLE ASSEMBLY 3/4" x 8'0" (19 x2440) DBL SWG
3074B	V	WD 3'6" (1065) POST#2, 3, 4, 5, 6 CAT
3075B	1	WD 3'6" (1065) POST #1 CAT
3100B	2	WD BLOCK 1'2" (360) #1 CAT
3101B	10	WD BLOCK 1'2" (360) #2-6 CAT
3255G	4	3/8" (10) FLAT WASHER
3263G	4	3/8" DIA X 2" (10 X 50) LAG SCREW
3275G	2	3/8" DIA. X 24 1/2" (10 X 620) RESTRAINT ROD
3300G	20	5/8" (16) WASHER
3320G	4	3/16" X 1 1/2" X 3" (5 X 45 X 75) RECT. WASHER
3340G	85	5/8" (16) HGR NUT
3360G	16	5/8" DIA x 1 1/4" (16 DIA x 35) HGR SPLICE BOLTS
3380G	8	5/8" DIA x 1 1/2" (16 DIA x 38) HEX BOLT
3395G	32	5/8" DIA. x 1 3/4" (16 DIA x 45) HEX BOLT CAT
3478G	13	5/8" DIA x 7 1/2" (16 DIA x 190) HEX HEAD BOLT
3497G	6	5/8" DIA x 9 1/2" (16 DIA x 240) HEX HEAD BOLT
3650G	2	5/8" DIA x 25" (16 DIA. x634) G.R. BOLT
3700G	V	3/4" (19) WASHER
3704G	V	3/4" (19) HEX NUT
3900G	4	1" (25) WASHER
3901G	4	1" (25) HEX NUT
4252B	V	WOOD POST - 6" x 8" x6'0" (150 x 200 x 1830) CRT FOR CAT
4640G	8	3/8" X 24" HEX BOLT
4258G	4	3/8" (10) LOCKWASHER
5148G	V	3/4" DIA x 9 1/2" (19 DIA x 240) HS HEX HEAD BOLT
9852A	1	CHANNEL STRUT X 6'6" (1980)
9915A	1	SPACER CHANNEL CAT
9916A	1	10/BENT PLATE SLEEVE
9921A	2	6" (150) SLEEVE 6" X 8" (150 X 200)
19259G	32	3/16" X 2" X 10" (5 X 50 X 255) PLATE WASHER
19261G	2	1/2" X 3" X 7" (13 X 75 X 255) POST PLATE
19271G	1	1" X 2 1/2" (25 X 63) PIPE SLEEVE CAT
33875G	1	6'6" (1980) ANGLE STRUT

V – VARIES DEPENDING ON VERSION OF CAT-350™ SYSTEM INSTALLED.

CAT- 350™

INSTALLATION INSTRUCTIONS

Trinity Highway Products' drawings for the CAT-350™ should be used in with these instructions. The states standard drawings for this system will need to be reviewed for details that are specific to that state.

MATERIALS

As packaged, your CAT-350™ system includes all materials needed for the installation from Post 1 up to and including Post 6.

A tail-end section is included in a second package of material needed to attach the CAT-350™ to the existing barrier or transition to fixed object. If the system is to be attached to a single-faced W-beam guardrail, the tail-end stops at Post 8, where the standard highway guardrail begins. If the system is to be attached to double-faced W-beam guardrail and less than 37'-6" of double-faced W-beam is used beyond the end of the CAT-350™, the tail-end section is required. If 37'-6" or more of double-faced W-beam is used, the tail section is not required. When a transition is used for the proper installation of the barrier system, the state's transition should be used.

Included with each CAT-350™ shipment is a can containing bags of attachment hardware. These bags are individually tagged showing the location of the posts where the hardware in that bag is to be used.

SITE PREPARATION

Site preparation requires the layout of a line establishing post locations. The CAT-350™ system is installed in a straight line. Posts are spaced at 6'3" (1905mm) on centers. No concrete footings or foundations are 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, wrenches, and such other equipment as augers and post pounders commonly used in driving posts.

INSTALLATION

Be sure adequate time is allowed for "Same Day" complete installation.

If there are special field conditions encountered when installing the CAT-350™, contact Trinity Engineering @ 1-800-644-7976 to review the conditions.

INSTALLATION

PLACING FOUNDATION TUBES

TUBE OPTIONS:

6'0" (1830 mm) Tube, no Soil Plate (Locations 1 through 6) No assembly required. Install the soil tube (PN-749G) as described below.

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

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) diameter pilot hole approximately 54" (1370 mm) deep and force the soil plate/tube assembly to the appropriate depth by impact or vibratory means with an appropriate 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) diameter pilot hole approximately 54" (1370 mm) or 72" (1830 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) diameter holes or one 24" (610 mm) diameter 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 FOUNDATION TUBES WHEN ENCOUNTERING ROCK

If rock is encountered when installing the tube(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, 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 granular material in the bottom 2 inches (50 mm) of the hole for drainage. Backfill and compact the hole after installing the tube. If compactable, the material removed from the hole may be used for the backfill.

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

INSTALLING WOOD POSTS IN TUBES

INSTALLING WOOD POSTS IN TUBES (LOCATION 1 AND 2)

A notched post (PN-3075B) is installed in the steel tube at post location 1. The notched side faces post 2. Before inserting the post in the tube, install pipe sleeve (PN-19271G) in the post.

Insert post (PN-3074B) in the tube at post location 2. Pipe sleeve (PN-705G) is installed in the top hole in the post.

Do not secure the post to the tube until the strut is ready to be installed. See the instructions for the installation of the strut for the connection.

INSTALLING WOOD POSTS IN TUBES (LOCATIONS 3 THROUGH 6)

When tubes are used at locations 3 through 6, insert post (PN-3074B) in each tube. 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 CRT POSTS (LOCATIONS 3 THROUGH 6)

Install the wood posts (PN-3118B) at all locations where the tubes 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.

INSTALLING THE STRUT

Place the angle ground strut (PN-33875G) on the embankment side of the foundation tubes. If the CAT-350™ is installed close to the center of a median, the strut can be placed on either side. A 3/4" (19 mm) diameter x 9 1/2" (240 mm) hex hd. high strength bolt (PN-5148G) is used to attach the strut to the foundation tube, and should be installed from the embankment side. A washer (PN-3700G) is placed between the bolt head and the strut and the nut (PN-3704G) and the foundation tube.

An alternate to the angle strut is the channel ground strut (PN-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 (PN-3497G) 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 (PN-3300G) is placed between the bolt head and the strut and the nut (PN-3340G) and the strut.

DO NOT OVERTIGHTEN THE BOLTS AND DEFORM THE TUBES.

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

INSTALLING WOOD BLOCKOUTS AND GUARDRAIL

There are no rail-to-post attachments at locations 3,5 and 6. Attach the wood blocks (PN-3101B), two (2) per post, at these locations using two 5/8" X 24" (16mm X 610mm) hex bolts (PN-4640G), hex nuts (PN-3340G) and washers (PN-3300G). The washers are placed under both the nut and bolt head.

Before installing any of the CAT-350™ rail panels, make sure the downstream rail is in place. This rail will either be the main line barrier or the tail-end section.

Start with the two (2) 10-gage rail panels (PC130A) that span from post 4 to post 6. These are the slotted rails with plates welded to the backside on one end. The welded plates are placed at post 4.

These rails are lapped to the outside of the rail extending beyond post 6. The rail splice at post 6 is made with eight (8) plate washers (PC-19259G) and eight 5/8" X 1-3/4" (16mm X 45mm) special hex head bolts (PN-3395G) and hex nuts (PN-3350G). The word "C-A-T"

should be stamped on the head of the bolt. This bolt has a portion of its shank purposely unthreaded. For functional reasons, DO NOT substitute with ordinary bolts at risk of changing the design concept.

Connect the welded plates of the 10-gage slotted rails, along with two (2) wood blocks, to post 4 with two (2) 5/8" X 24" (16mm X 610mm) hex bolts (PC-4640G), hex nuts (PC-3340G) and washers (PC-3300G). The washers are placed under both the nut and bolt head. Be sure to tighten the nuts before attaching the 12-gage rail.

The two (2) 12-gage slotted rails are positioned with the 210mm (8-1/4") long slots at post 4. The four (4) 3/4" (19mm) diameter holes are at the post 2 end.

The 12-gage slotted rails (PC-31G) are lapped to the outside of the 10-gage rails at post #4. Again, eight (8) plate washers and eight (8) 16mm X 45mm (5/8" X 1-3/4") hex bolts and hex nuts are used to make the connection.

Attach the rail at post 2 with two (2) wood blocks, using a 5/8" X 25" (16mm X 635mm) post bolt (PN-3650G), two (2) rectangular washers (PN-3320G) and a hex nut (PN-3340G). Before tightening the rails and blocks to post 2, install between the rails the spacer channel (PN-9915A) downstream from post 2. Locate the spacer channel so that brace with the 1-1/4" (32mm) diameter hole is closest to post 2. Attach the spacer channel to the rails with eight (8) 5/8" X 1-1/2" (16mm X 40mm) hex bolts (PN-3380G) and hex nuts (PN-3340G).

ASSEMBLING THE NOSE SECTION

Bolt the side plates (PN-984G) to the end of each 12-gage rail panel, using four (4) 5/8" X 1-1/4" (16mm X 32mm) splice bolt (PN-3360G) and hex nut (PN-3340G).

A tube sleeve (PN-9916A) is placed over post 1. The nose section (PN-983G) is attached to post 1 using a 16mm X 635mm (5/8" X 25") post bolt (PN-3650G). Narrow wood blocks (PN-3100B) are placed between the nose section and the post. Rectangular washers (PN-3320G) are placed between the bolt head and nose section and the hex nut (PN-3340G) and the nose section. Excess threads should be cut off and peened.

Bolt the nose section to the side plates, using eight (8) 5/8" X 1-1/4" (16 mm X 32mm) slice bolts (PN-3360G) and hex nuts (PN-3340G).

INSTALLING THE CABLE ANCHOR ASSEMBLY

Slide one end of the cable (PN-3012G) through the pipe sleeve at the base of post 1. Place the bearing plate (PN-782G) over the cable stud with the 5" (125 mm) dimension up and the 3" (75 mm) dimension down. Place a 1" (25mm) washer (PN-3900G) over the end of the cable assembly. Secure the end of the cable assembly with a 1" (25mm) hex nut (PN-3910G) and tighten. Prevent the bearing plate from rotating by driving two nails along its top edge and bending them over.

Slide the other end of the cable through the pipe sleeve at the top of post 2 and then through the 1-1/4" (32mm) diameter hole in the spacer channel. Place a 1" (25mm) washer (PN-3900G) over the end of the cable assembly. Secure the end of the cable assembly with a 1" (25mm) hex nut (PN-3910G) and tighten. The cable should be made taut by tightening on this end. Restrain the cable with vise grips to avoid twisting the cable

A second 1" (25mm) nut is added to each end of the cable assembly to prevent loosening.

INSTALLING THE KNOCKOUT BLOCKS AND POST PLATES

Connect the knockout blocks (PN-9921G) to the upstream side (toward the nose) of posts #4 and #6 with two (2) 3/8" X 2" (10mm X 50mm) lag screws (PN-3263G) and a flat washer (PN-4257G) under the lag screw head. The knockout blocks should be installed parallel to the ground and should be located 4" (100mm) down from top of the post.

Attach post plates (PN-19261G) to the top of post 4 with a 5/8" X 7-1/2" (16mm X 190mm) hex bolt (PN-3478G) and hex nut (PN-3340G).

INSTALLING THE RESTRAINING RODS

Install the buckling restraining rod (PN-3275G) in the slot (behind post 5) of the 10-gage rail panels and in the slot (behind post 3) of the 12-gage rail panels. The 3/8" x 24-1/2" (10mm X 620mm) restraining rod is threaded on each end. A nut (PN-4252G), lock washer (PN-4258G), and another nut is placed on each end. The completed assembly is inserted through the holes in the rail panel, with one nut and lock washer on the inside of the rail panel and the other nut on the outside of the rail panel. The assembly is placed in the smaller slotted hole. The two outside nuts are snugged up to the rail panels. The inside nuts are now snugged up to the inside of the rail panels.

INSPECT THE COMPLETE INSTALLATION

Inspect the complete installation to ensure all parts are located in proper position and all nuts have been tightened. Your CAT-350™ system is now ready to enter service

CAT-350™
INSTALLATION CHECK LIST

STATE: _____
DATE: _____
PROJECT: _____
LOCATION: _____

- Proper and uniform rail height (27 ¾")
- Post #1 notched side faces post #2.
- Proper orientation of bearing plate. (5" up, 3" down)
- Soil plates verified with foundation tubes. (Downstream side when required)
- Anchor cable is taut and correctly installed.
- Guardrails spanning from posts #2 to #4 are 12 gage (PC-31G) and are positioned with the 210mm (8-1/4") long slots at post #4.
- Guardrails spanning from post #4 to #6 are 10 gage (PC-130A) and are positioned with the welded attachment plates at post #4.
- No rail attachment at posts #3, #5 and #6.
- But a restraint rod attached just downstream of posts #3 and #5.
- Rail splices at posts #4 and #6 permit telescoping.
- Rail lapping at posts #4 and #6 include plate washers and PC-3395G special splice bolts.
- Knockout tubes are in place on the upstream sides of posts #4 and #6, with post plates at post #4.
- Tail end and/or transition as required have been installed in accordance with the contract plans.

CAT-350™

MAINTENANCE INSTRUCTIONS

MAINTENANCE FOR THE CAT-350™ CAN BE CATEGORIZED AS ROUTINE OR REPAIR.

Routine maintenance consists of periodically checking the system to see that the cable is taut and the blockouts have not rotated.

REPAIR MAINTENANCE DEALS WITH THE SYSTEM AFTER IT HAS BEEN HIT.

The CAT-350™ is designed to collapse in stages when it is impacted on the end. Depending on the severity of the impact, repair may consist of replacing only: stage one, the 1905mm (6'-3) nose section; stages one and two, the nose section and 3810mm (12'-6) set of 12-gage panels and posts; or all three stages of the above ground parts of the complete CAT- 350™ .

In any event, the CAT-350™ replacement parts may be ordered in stages or by the individual parts. A parts list by stages may be obtained from Trinity Industries by calling (800)644-7976.

THE FOLLOWING STEPS SHOULD BE TAKEN IN MAKING REPAIRS:

- (1) Set up the necessary work zone control devices.
- (2) Make note of the broken wood posts and wood blockouts that need to be replaced.
- (3) Inventory and pick up the reusable parts.
- (4) Bring necessary replacement parts from the maintenance yard.
- (5) Disconnect and remove the damaged rail and material from the system.
- (6) The broken posts in the steel tubes can be removed using one of the post removal tools recommended that can be assembled from 'off-the-shelf' hardware items
- (7) After the site has been cleared of damaged material and debris, the system can be reconstructed following the construction installation instructions.



2525 Stemmons Freeway

Dallas, Texas 75207

888-323-6374 (USA only)

214-589-8140 (Outside USA)

www.energyabsorption.com

www.highwayguardrail.com