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SYSTEM DESCRIPTION

The Crash Cushion is a redirective, non-gating, bidirectional crash barrier designed to protect roadside hazards from out-of-control vehicles in a manner, which reduces the vehicle occupant’s exposure to risk. The Crash Cushion achieves this goal while usually being completely reusable after each event and only requiring minimal replacement of consumable parts from a direct frontal or side impact.

The Crash Cushion is delivered from the factory completely assembled and ready to install. No field assembly is required.

The Crash Cushion has been tested and certified based on the requirements of NCHRP 350 for Level 2 & 3 service. This includes stopping or redirecting 2000 kg (4400 lb) pickup trucks as well as 820 kg (1800 lb) light passenger cars within NCHRP 350 guidelines.

Proper performance within these limits depends on correct installation of the system on an approved foundation. Any Crash Cushion not installed according to the drawings and the requirements of this installation manual may present an unsafe condition and should be re-installed accordingly.

Impacts with vehicles whose size or mass are outside of those tested according to NCHRP 350 or with vehicles traveling at speeds greater than those tested according to NCHRP 350 will not necessarily produce results within the test criteria. While the tests account for most crash conditions, they do not cover all situations. The Crash Cushion is in conformance with the requirements of NCHRP 350 Level 2 & 3 but is not guaranteed to safely stop a vehicle in a situation not encompassed by the test conditions.

SAFETY

All work during installation, repair and inspection of the Crash Cushion should be performed according to Federal, State and Local laws.

The Level 2 & 3-24” Hazard Crash Cushion is described by the following drawing:

Mechanism

SCI100GM – SEE APPENDIX – FIGURE 1 - ASSEMBLY DRAWING
SCI70GM – SEE APPENDIX – FIGURE 1A - ASSEMBLY DRAWING
EQUIPMENT LIST

Installation and Resetting

The following tools and equipment will be required to install and repair the Crash Cushion:

- Standard roadside work area safety equipment
- Personal safety equipment (gloves, eye/face protection, etc.)
- Means of safely unloading 3500lb.
- Compressed air source/Vaccum and bottle brush
- Safety Goggles
- Four Lifting Slings or Four Point Sling
- Rotary Impact Drill for concrete
- 7/8” X 14” or longer concrete drill bit
- Epoxy system for anchor bolts
- Combination Wrench and Deep Sockets (Including 1 ¼”, 1 ½”, 1 5/8”)
- Socket Wrench and Breaker Bar
- Torque wrench (225 ft-lb capacity) with 3’ extension
- Measuring and Layout Equipment (tape measure, chalk line, markers, etc.)
- Two 6’ pry bars
- 7/32” Allen Wrench
- Suitable Pulling Means (strap or chain)
- Come-Along
- 2 – long handled flat screwdrivers
- Misc. small tools (hammers, pliers, screw drivers, vise grips, etc.)

This list is adequate for general installation and repair. However, depending on site conditions, additional tools and equipment may be required.

FOUNDATION

Any of the following foundations will meet the requirements:

- 6” Reinforced Concrete Pad
- 8” Unreinforced Concrete Pad
- 3” Asphalt over 3” of Concrete
- 6” Asphalt over 6” of Compacted Subbase
- 8” Asphalt

Note: Concrete should be 28 Mpa or 4000 PSI minimum at full cure.

Installing the Crash Cushion on an existing foundation may result in anchor bolt locations corresponding to rebar positions in the foundation. It may be necessary to use more elaborate drilling equipment than simply an impact drill with standard concrete bits.

Prior to installing the Crash Cushion on an existing foundation, the concrete must be thoroughly inspected for signs of cracking, surface wear, shifting from original position, undercut of earth below or to the sides supporting the foundation, settling, and any other signs of age or deterioration which may make the foundation unusable. If any of these signs are evident, the foundation must be removed and a new one must be installed according to requirements stated
earlier. If prior bolt patterns are present, use proper engineering calculations to assure adequate strength in the new holes.

INSTALLATION INSTRUCTIONS

Site Preparation

New foundations should be installed according to APPENDIX – FIGURE 2 – FOUNDATION DRAWING. Concrete should reach full cure strength before use. The surface of the foundation must be cleaned of all debris, dirt, mud, sand, etc., as the Crash Cushion must sit on a straight surface.

Placement of the Crash Cushion

Measure the correct distance and offset of the Crash Cushion according to the type of obstruction being shielded and the type of transition being used. The dimensions shown on the transition drawings may be used as a guide for this.

The Crash Cushion is shipped in one piece, fully assembled. Using a choked four-point attachment on panel support frames #3 & #4 behind the sled, lift the Crash Cushion off of the transporting vehicle with a boom or forklift of sufficient capacity and place it in the position marked on the foundation.

Once in place, double-check the measurements one more time to be sure of the proper location of the Crash Cushion.

Warning: Side Panels can telescope 30” beyond the last Terminal Brace at the rear of the Crash Cushion. All objects that may interfere with this motion can affect the performance of and cause undue damage to the Crash Cushion.

Anchor Installation

Embedment Requirements are as follows:

- 6” Reinforced Concrete Pad with anchor embedment of 5.5”
- 8” Unreinforced Concrete Pad with anchor embedment of 5.5”
- 3” Asphalt over 3” of Concrete with anchor embedment of 16.5”
- 6” Asphalt over 6” of Compacted Subbase with anchor embedment of 16.5”
- 8” Asphalt with anchor embedment of 16.5”

Using the holes in the base as a template, drill 7/8” holes to the proper depth as previously defined. If the Crash Cushion is being installed on an existing foundation and the drills are hitting rebar, use a core drill or similar system to ensure that straight, vertical holes are made at each location. Take care that the holes do not break out the bottom of the foundation as this may result in loss of epoxy during anchor placement.

Once the holes are drilled, clean the hole of all debris using suitable means, then scrub out the hole with a bottle brush. Remove dust one final time and ensure holes are clean of debris and dry. Inject the epoxy into each hole at an angle so as to avoid air entrapment. Use the proper amount of epoxy so that the hole will be filled when the bolt is inserted. Screw the nut on the
anchor bolt flush with the end, put washer on the stud and immediately insert the anchor stud all the way to the bottom while turning the anchor. This method assures the anchor bolts are vertically plumb and the threads are coated with epoxy.

Our Epoxy will be ready for bolt tightening after 90 minutes at 78 degrees F (25 degrees C), with full cure at 24 Hours, see the container label for other temperatures and bolt up times. After sufficient time has passed to allow the epoxy to cure, torque the anchor nuts to 170 N-m (125FT-LB).

**Nose Piece Installation**

Installation of the front delineation plate will be determined by the use of the attenuator and state regulations. A delineation plate is shipped with the yellow background applied and no striping. It is attached by four bolts. Applying the striping to the plate is easier while it is removed from the attenuator due to the holes that need trimming. Examples of the delineation plate are as follows:

![Right Shoulder](image1) ![Gore Area](image2) ![Left Shoulder](image3)

**Transition Installation**

Transitions may be required. Any use of a Crash Cushion with a possible reverse direction impact will require a transition. In all applications, be sure to install the transition anchors so that there is no extension of the studs beyond the outside face of the nut. Refer to the transition drawings for details of the required anchor locations. For horizontal stud installation in concrete, use mechanical anchors or repeat the same epoxy installation process as the anchor bolts using plugs to retain the epoxy to secure the transition to the barrier.

**Final Inspection**

After the anchor bolts have been tightened to the proper torque value, check that the Crash Cushion is not distorted in any way as might happen if the unit is secured to a foundation, which is not a straight surface. Check that the front section is pulled out all the way to the front stop bolts and that no part of the unit has been damaged by shipping and handling. Verify that all assembly bolts are tight and have not come loose during shipping or installation. Finally, check that no tools or other equipment have been left within the Crash Cushion structure.
RESETTING CRASH CUSHION AFTER IMPACT

In the event of any impact, the Crash Cushion will require a full evaluation to determine the necessary repairs to return it to service. To do this, proceed as follows:

Site Preparation

**Do not begin work until all accident debris has been cleared and the area declared safe and accessible by government authorities.**

Re-Extension and Inspection after Frontal Hit

- Remove the Spelter Socket pin from the front sled by removing the cotter pin and pulling it out. **If there is tension, pull out the sled a few inches to relieve the tension.**
- Use two long handled flat screw drivers to break cable loose from the sheave at the front of the attenuator if the zinc coating has attached the cable to the sheave. This procedure may also be needed on the rear sheaves. **The cable must move freely.**
- You then should hand pull the Spelter Socket side of the cable all the way out of the front of the attenuator to eliminate friction during pull out. You must first remove the front cable bracket then you can push the cable from behind while prying in front to start a loop.
- Inspect front part of the cable from the Spelter Socket, as it will be partially obscured after extension of the mobile frames and sheaves. **See the cable inspection procedure.**
- Remove the front delineator panel and attach pulling means to the bottom brace of the front sled. Pull the unit out until it reaches the front stop bolts. When fully pulled out, reattach the Spelter Socket onto the sled.
- Remove the front and rear sheave cover plates located on each end of the cylinder by removing the two cap screws that hold them down. See APPENDIX - FIGURE 3
- Remove the anti-rotation pins, which are the two outer pins, inserted through the holes in the sheaves from both the front and back sheaves. **Caution: do not remove the center pin.** Also, the rear pins are longer than the front sheave pins and cannot be intermixed.
- Check for shear bolt remnants in the holes on both sides of the mobile sheaves.
- Attach pulling means to the mobile sheaves.
- Slowly pull out the mobile sheaves while inspecting the cable. Be sure the cable doesn’t ride up over the front sheave as the slack is reduced. Do not stand inside the cable loop or be in the pulling strap danger zone.
- Finish pulling out the mobile sheaves. They are in the proper position when you can replace two 1/4” Grade 8 shear bolts in the front corners of the mobile sheaves. Loosen the cable adjustment bolt if necessary to install shear bolts.
- If the cable passes inspection, reinstall the anti-rotation pins in the front and back sheave assemblies and reinstall the cap screws in the cover plates for those sheaves. The sheaves may be aligned by inserting a pry bar into the sheave holes.
- Tighten the cable adjustment bolt to remove any slack in the cable. If there is too much slack to tighten the cable, replace the cable as repositioning the wire rope clips should not be performed because the cable is stretched beyond tolerances.
- Inspect the cylinder, anchor bolts and side panels according to the procedures listed after this section.
Side Hit Inspection and Repair

- Inspect and replace any damaged side panels.
- Inspect and replace any damaged side keeper bolts on all panels. There are three styles of 
  keeper bolts. The winged style is for the panel connected to the sled and bolts through the 
  first frame behind the sled. The center keepers have a .5” shoulder while the last keeper, 
  which is bolted to the terminal frame, has a .25” shoulder.
- Inspect and repair any damaged side guides.

Cable Inspection and Replacement Procedure

The cable should be visually inspected for damage. The most common sign of rope deterioration 
is broken wires. The wire must be clean and not under tension to perform a visual inspection. 
Visual inspection should include looking for broken wire strands, localized wear or crowns. A 
sharp awl or marlin spike can be used to separate wires to check if internal damage is present, 
indicated by loose wires or crowns. If internal inspection shows any damage to any core wires, 
the cable should be replaced. If there are more than six random broken wires in one rope lay or 
three broken wires in one strand in one rope lay, the wire rope should be replaced. A rope lay is 
the length along the rope in which one strand makes a complete revolution around the rope.

Inspect the Spelter Socket for broken wires, damaged eyes or other fatigue. Any signs of broken 
wires at the Spelter Socket will require a new cable.

Replacement of the cable may be required. The anti-rotation pins in the sheaves will need to be 
removed for this procedure. Remove the wire rope clips on the old cable and pull the unattached 
Spelter Socket out through the front of the attenuator. Feed the new cable through the front 
sheave bell reducer, wrap around the sheave and back to the bottom rear sheave. Insert a pry bar 
through the holes to the rear of the sheaves to help guide the cable around the sheave. The cable 
arrangement travel path is as follows: bottom rear sheave, bottom front sheave, middle rear 
sheave, middle front sheave, top rear sheave, top front sheave to cable adjustment bolt. The 
cable will be marked where the Cable Adjustment bend will be. Attach the Spelter Socket. 
Adjust the cable adjuster eyebolt all the way out and thread cable through the eye loop. Wrap 
cable back against itself with the mark at the bolt eye. Start wire rope clips on the ends of the 
large loop. Work the wire rope clips up by clamping the wire rope loop in front of the clips. 
Work the last clip up to 4” from the eyebolt loop. Then position the other three wire rope clips 
back at 3” intervals. When the wire clips are all positioned, tighten them to 225 ft. lbs or 305 n- 
m.

Cylinder Inspection

The cylinder should be inspected for:
- Dented or swollen tube jacket
- Visible cracks in any welds and fluid leakage from the welds
- Piston rod surface damage, bending or fluid leakage in seal area
- If fully collapsed or over design impact speed, disconnect piston rod from the mobile 
sheave after the unit is pulled out and push the piston rod in checking for free movement.

If any of these inspections are suspect, replace cylinder and have it examined by the 
manufacturer. Once the cylinder seal is seated in oil, the field life is 15+ years per manufacturer.
Anchor Bolt Inspection

Anchor bolts may come loose or damaged upon impact. These bolts can be replaced by welding a nut or putting a double nut on them and backing them out of the hole. Drill out the old epoxy and reinstall new bolts with new epoxy.

Side Panel Inspection

Side Panels are designed to nest and collapse with minimal or no damage upon frontal impact. The side panel bolts do sustain a shock upon impact. These bolts should be replaced if there are any signs of fatigue, bending or other visible damage. Inspect the side panels for any bending or torn metal. If damage is found, all side panels are removable by removing four bolts. It may be necessary to remove the bolts on the panel upstream to slide out a panel located in the middle of the unit. The side panel bolts used to hold the large front sled panels are different than the bolts on the center panels. Also, the panel side bolts used on the last terminal brace, which is the rearmost support, has a shorter shoulder (.23” vs .49”), as it does not have a panel overlap. These shoulders must seat into the outer overlapping panel and pin the inside panel to the frames using a torque value of 270 N-m (200 FT-LB). Be careful not to pin the edge of the outside panel as it will restrict free sliding of that panel.

Side Guide Inspection

At the bottom of each support frame, there is a guide to stabilize and guide collapse of the attenuator. Inspect each side guide for damage. These guide assemblies are very rugged. The attachment bolt should be removed and inspected on all frames impacted during a side impact. The guides should be inspected for any damage and if they are not damaged, they can be reused. Upon frontal impact, these guides should be inspected for damage. The Torque value for the Side Guides is 920 N-m (680 FT-LB).

Final Inspection

After the resetting of the Crash Cushion is complete, verify by visual inspection that all assembly bolts are tight and show no sign of damage. Finally, check that no tools and other equipment or debris have been left within the Crash Cushion structure. Verify that no other damage unrelated to the most recent impact has occurred and that no significant corrosion or other deterioration has taken place.

Non-Repairable Impacts

There can be instances where the impact is outside the scope of the Crash Cushion’s design. This may render the Crash Cushion unsafe to reuse and it should be replaced.
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<th>Unit of Measure</th>
<th>Spare Parts Kit</th>
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*** P/N 9400 - Includes 4-Epoxy Cartridges & 4-Mixing Nozzles
*** P/N 9450 - Includes 12-Epoxy Cartridges & 12-Mixing Nozzles
*** P/N 9451 - Includes 3-Epoxy Cartridges & 3-Mixing Nozzles
*** P/N 9452 - Includes 9-Epoxy Cartridges & 9-Mixing Nozzles

### Transitions and Transition Parts

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O = Optional
Revised 4-6-05
APPENDIX - FIGURE 1 - TL3 ASSEMBLY DRAWING

PARTS LIST
01 - Front Sled
02 - Cable Assembly
05 - Sled Panel
07 - Terminal Brace
09 - Anchor Bolts
12 - Side Panels
14 - Mobile Sheave Asbly
17 - Cable Adjuster Bolt
18-23 - Mobile frames 1-6
26 - Cylinder
27 - Rear Panel
06,08,29 - Side Keepers

Serial number location
APPENDIX - FIGURE 1A - TL2 ASSEMBLY DRAWING

PARTS LIST
01 - Front Sled
02 - Cable Assembly
05 - Sled Panel
07 - Terminal Brace
09 - Anchor Bolts
12 - Side Panels
14 - Mobile Sheave Asbly
17 - Cable Adjuster Bolt
18-23 - Mobile frames 1-6
26 - Cylinder
27 - Rear Panel
06,08,29 - Side Keepers

Serial number location
Cross Slope at Top Surface Not to Exceed 1 in 12
Cross Slope Not to Vary More Than 1 in 48

**SPECIFICATIONS**

All reinforcing steel - straight #4 ASTM-A36

Embedment requirements:
- 6" reinforced concrete pad with anchor embedment of 5 3/4"
- 8" nonreinforced concrete pad with anchor embedment of 5 3/4"
- 3" asphalt over 3" of concrete with anchor embedment of 16 1/2"
- 6" asphalt over 6" of compacted subbase with anchor embedment of 16 1/2"
- 8" asphalt with anchor embedment of 16 1/2"

The contractor shall furnish a certification for material installed to the following requirements:
- 6" reinforced concrete (PCC) sampling per ASTM C31-84, testing per ASTM C39-84
- 8" nonreinforced concrete (PCC) sampling per ASTM C31-84, testing per ASTM C39-84
- 3" asphalt over 3" of concrete - Type SP 12.5 Level C or higher
- 6" asphalt over 6" of compacted subbase - same as above
- 8" asphalt (AC) - Type SP 12.5 Traffic Level C or higher
APPENDIX - FIGURE 4 - JERSEY BARRIER TRANSITION
Right Hand Model Shown

Parts List:
Transition Jersey Barrier - Right #9431
Transition Jersey Barrier - Left #9432
Parts List:
Transition 24" Concrete Block Right & Left #9431

APPENDIX - FIGURE 5 - CONCRETE BARRIER TRANSITION

END TREATMENT ASSEMBLY
SEE ET-00-01

END OF ITEM 06 FLUSH
WITH FACE OF NUT
4 PLCS

TRANSLATION ON ONE
OR BOTH SIDES
AS REQUIRED

DRILL #5/16 x 5 1/4 DP
SECURE WITH 8D8@4
4 PLCS
Start of standard w-beam guardrail

18 ¾”
5 Spaces at 18 ¾”
3 Spaces at 37 ½”
2 Spaces at 37 ½”

Posts 1-9: PDE03 with the two optional holes, 78” length, 44 ¼” embedment

Overlap rails such that exposed edges do not cause snagging with incoming traffic

Post 10: PDE03, Trim 2” from top of post

Sci_Gm

Sci_Gm to thrie beam transition section

33 ¼” 1 ¼”

Blockouts for posts 1 and 2: PDB01 (two per post), or use similar to Part 15 (figure 7) in original design

Blockouts for posts 3-9: PDB02

Blockout for post 10: PDB02, Trim 2” from top and bottom of blockout

APPENDIX - FIGURE 6 W-BEAM TRANSITION ASSEMBLY
Right Hand Transition Shown
Overlap rails such that exposed edges do not cause snagging with incoming traffic.

Posts 1-8: PDE03 with the two optional holes, 78" length, 44 ¾" embedment

Blockouts for posts 1 and 2: PDB01 (two per post), or use similar to Part 15 (figure 7) in original design

Start of Standard thrie beam guardrail

Nested (2) thrie beam rails: RTM02a (gauge 12)

Blockouts for posts 3-8: PDB02

APPENDIX - FIGURE 7 - THRIE BEAM TRANSITION ASSEMBLY
Right Hand Transition Shown
APPENDIX - FIGURE 8 - 30" CONCRETE TRANSITION ASSEMBLY
APPENDIX - FIGURE 9 - 30" CONCRETE TRANSITION ASSEMBLY
Outboard Connection
Parts List:
- Two Sided Full Assembly #9460
- 01-Transition 36" Concrete Straight Connection #9464
- 12-Transition Concrete Spanner Brace #9469
- 13-Transition Concrete #1 Tapered Spanner Brace #9470

APPENDIX - FIGURE 10 - 36" CONCRETE TRANSITION ASSEMBLY
APPENDIX - FIGURE 11 - 36" CONCRETE TRANSITION ASSEMBLY
Outboard Connection
**APPENDIX - FIGURE 12 - WIDE TAPER TRANSITION ASSEMBLY FOR CONCRETE AND ASPHALT**

**Parts List:**
- 01-Transition Thrie 10 Degree Flare Right #9467
- 01-Transition Thrie 10 Degree Flare Left #9468
- 10-Transition Concrete Spanner Brace #9469
- 11-Transition Concrete #1 Tapered Spanner Brace #9470
- 12-Transition Gore Tapered #1 Spanner Brace #9472
- 13-Transition Gore Tapered #2 Spanner Brace #9473
- 14-Thrie Beam Concrete Leg Brace #9474
- 15-Thrie Beam Blockout AASHTO PWB02
- 16-Hardware AASHTO FBX16a

**NOTES:**
*Dimensions shown are for 60" width for each 1" of width change add or subtract the following:
- 2.88" (73.15mm) to length of each Guardrail
- 2.84" (72.13mm) to overall length
*Add or subtract additional post on each side for each 13" (330 mm) change in width

The use of the last brace will be determined by whether the Thrie Beam can be attached to the obstruction or not. If the Thrie beam distance from the last brace is 40 inches or less and can be attached, you will not need a brace at the obstruction. If you cannot attach to the obstruction, you may need a brace and drill holes in the Thrie Beam at the furthest rearward location.
APPENDIX - FIGURE 13 - 42" Double Sided Concrete Median Barrier Transition with 36" Base

Parts List:
Two Sided Full Assembly #9476
01-Transition 42" Double Sided Median Barrier-Right #9477
01-Transition 42" Double Sided Median Barrier-Left #9478
09-Transition 42" Double Sided Median Barrier Spanner Brace #9479
13-Transition 42" Double Sided Median Barrier Rub Rail-Right #9480
13-Transition 42" Double Sided Median Barrier Rub Rail-Left #9481