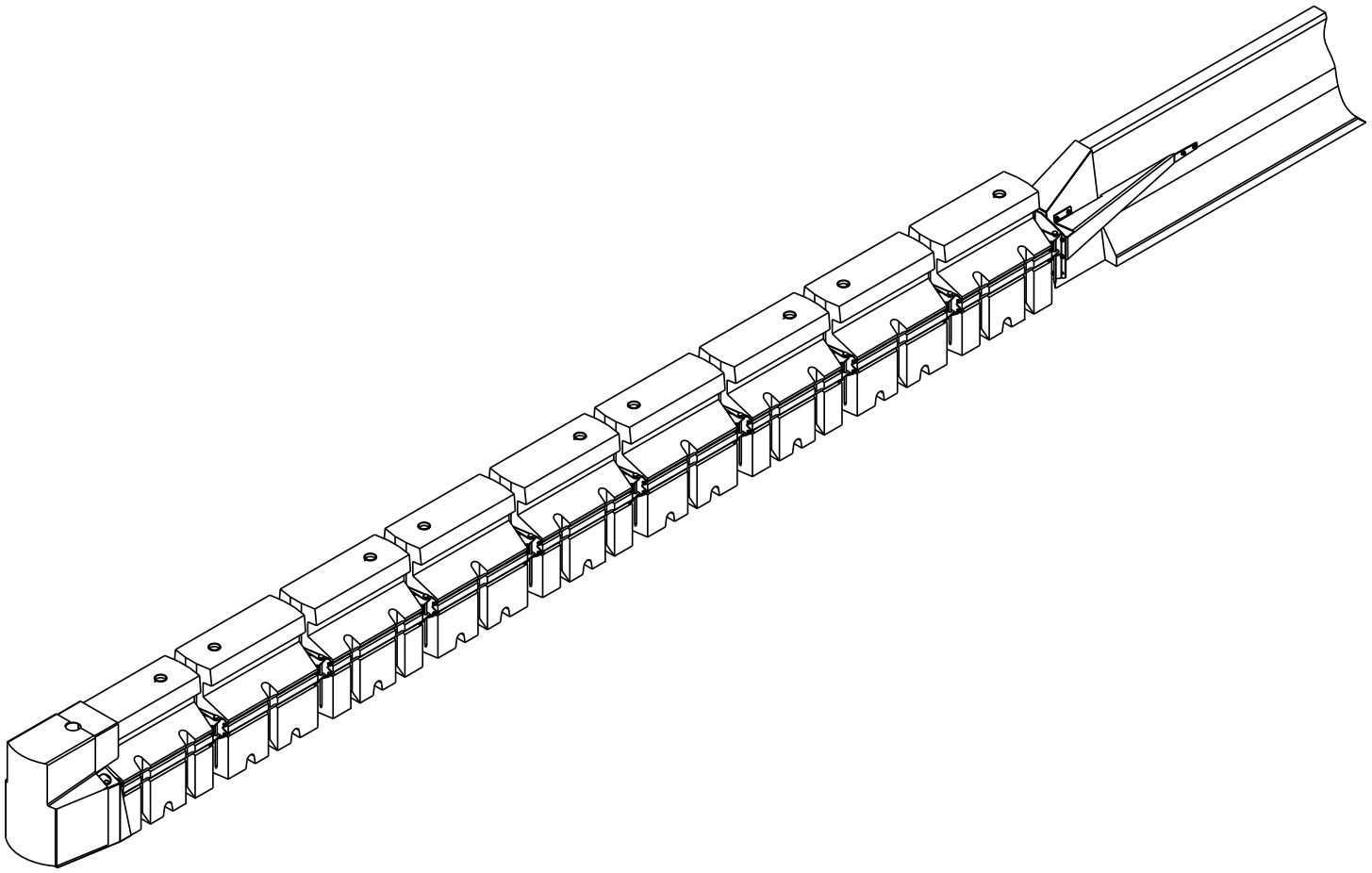
ABSORB 350® BARRIER

NCHRP 350 TL-3 Non-Redirective Crash Cushion



BARRIER SYSTEMS®
BY LINDSAY

PATENTS PENDING

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PREFACE

The Barrier Systems, Inc. (BSI), ABSORB 350® crash cushion system incorporates the newest roadside safety materials and engineering processes.

As with any roadside safety device, the ABSORB 350 system must be installed properly to ensure proper performance. Thoroughly review and fully understand the installation instructions and product limitations before starting the installation. An instructional video is available from BSI to help explain the general installation requirements. Watch and fully understand the ABSORB 350 *Installation and Assembly Video* before attempting to install this crash cushion. Do not start the installation without the proper plans and tools required for installation.

If you need additional information, or have questions about the ABSORB 350 Crash Cushion, please call the BSI Customer Service Department at (888) 800-3691 (U.S. toll free) or (707) 374-6800.

INTRODUCTION

The ABSORB 350 system has been tested to meet the rigorous requirements of NCHRP Report 350, Test Levels 2 and 3. The system attaches to portable, permanent, and moveable concrete barrier.

The ABSORB 350 system is a non-redirective, gating crash cushion that has superior overall performance to sand barrels for narrow hazard protection, with similar performance characteristics to other non-redirective, gating crash cushion systems. ABSORB 350 is easy to install and requires no foundation or anchoring. It is easy to maintain, and it restores in minutes after impact.

The ABSORB 350 system has been fully tested in conformance with NCHRP Report 350 and approved by the U. S. DOT Federal Highway Administration as well as several countries outside of the U.S. Non-redirective, gating, crash cushions are frequently used at locations where it is desirable for the vehicle post impact trajectories to be behind the system. If it is desirable to have the majority of post impact vehicle trajectories on the impact side of the system, a redirective, non-gating crash cushion should be considered.

SYSTEM OVERVIEW

The ABSORB 350 system is designed and constructed to provide acceptable structural adequacy, minimal occupant risk and safe vehicle trajectory as set forth in NCHRP 350 for a Non-Redirective, Gating, Crash Cushion. Individual sections of the system are linked and pinned together to form a continuous freestanding installation (the system is not anchored to the foundation surface). The effective length of each element is 1m and the effective overall height is 800 mm. The effective width of the upright portion of each section is 61 cm. Each section is fabricated out of a roto-molded shell that is filled with water and fitted with steel hardware to allow the sections to be connected. The mass of each section is approximately 50 kg (110 lbs.) empty and 315 kg (695 lbs.) filled.

REQUIRED TOOLS

½" (12 mm) drive deep sockets:
19 mm, 24 mm

Open / box end wrench:
19mm, 24mm

½" (12 mm) drive ratchet with extensions

Rotohammer for drilling holes in concrete:
1/2" (12 mm) X 10" (250 mm) bit

Measuring tape

Safety equipment: glasses, gloves ½"

Air impact wrench (Optional)

3" Hole saw (for drilling second hole in some elements)

Round tapered aligning bar

Note: The tools list is a general recommendation. Depending on the specific characteristics of the job site, additional tools may be necessary.

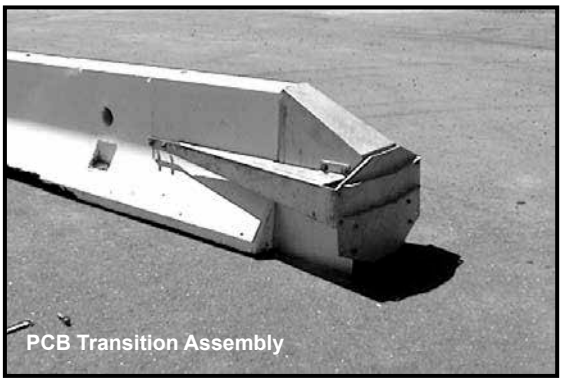
BEFORE ABSORB 350 INSTALLATION

Placement and use of the ABSORB 350 system should be accomplished in accordance with the guidelines and recommendations set forth in the "AASHTO Roadside Design Guide," FHWA memoranda and other state and local standards.

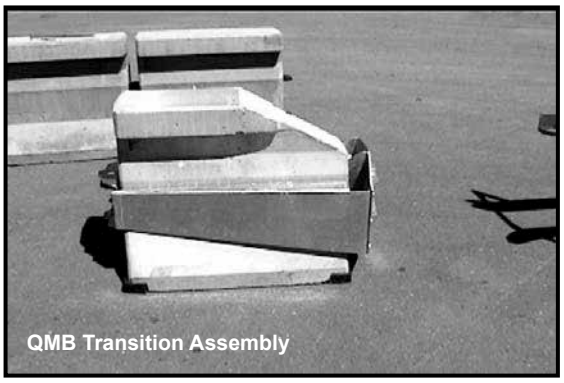
Depending on the application and circumstances at the job site, installation and assembly should take a two-person crew less than 1 hour.

The ABSORB 350 is a highly engineered safety device made up of a relatively small number of parts. Before starting the assembly, become familiar with the basic elements that make up the ABSORB 350 system.

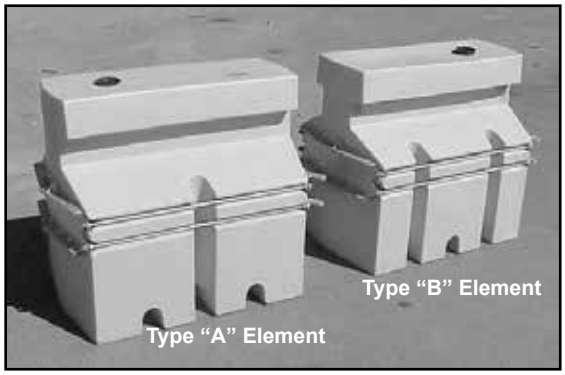
Installing the ABSORB 350 is as easy as A - B - C


PCB Transition Assembly

OR


QMB Transition Assembly

A – Install either the PCB or QMB Transition Assembly - Page 5


Type "B" Element

Type "A" Element

B – Assemble the ABSORB 350 elements (PCB OR QMB style) – Page 12


PCB Nose Piece

OR


QMB Nose Piece

C – Install either the PCB or QMB Nose Piece - Page 14

PATENTS PENDING

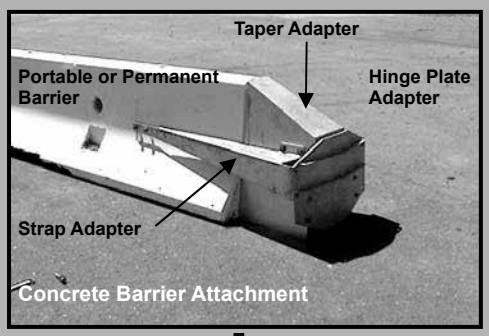
The transition installation portion of this manual is split into two columns.

CHOOSE THE TYPE OF TRANSITION

PCB or **QMB**

Follow the instructions for the transition you are installing

PCB TRANSITION



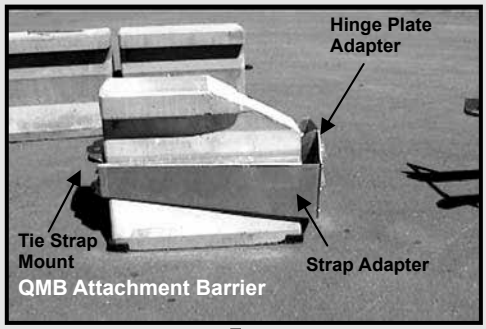
INSTALLATION TO PCB

One or two people can easily accomplish the initial installation. **The installation should be completed prior to filling the energy absorbing elements with water.** Start installing the transition assembly first at the concrete barrier wall end and assemble towards the nosepiece. ***Before starting the installation, open and inspect all of the hardware kits. Lay out all nuts, bolts and washers as needed for the installation.***

STEP 1
Attach the PCB transition to the concrete barrier using the pin and loop system.

NOTE: For installation to a Permanent Concrete Barrier skip to step 1.8.

QMB TRANSITION



INSTALLATION TO QMB

One or two people can easily accomplish the initial installation. **The installation should be completed prior to filling the energy absorbing elements with water.** Start installing the transition assembly first at the QMB wall end and assemble towards the nosepiece.

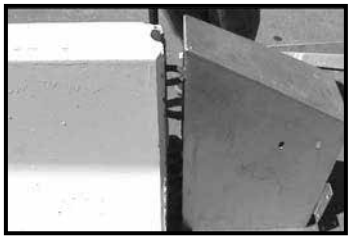
STEP 1
Install the transition hardware on the QMB Attachment Barrier. **Do not attach the transition hardware to a Standard QMB Barrier. The system will not function as designed without this special sloped barrier. Severe injury may occur.** Use the following steps to install the transition hardware.

PCB TRANSITION

1.1 Insert the Anchor Bolts through the holes in the adapter. There are two sets of holes in the adapter; use the holes on the top of each set.

1.2 Install the nuts with washers on the end of the anchor bolts that are now on the inside of the transition.

1.3 Remove the pin from the end of the PCB.



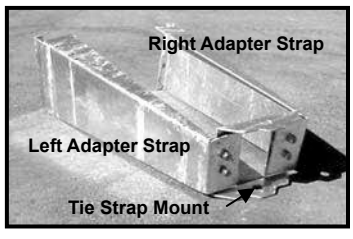
1.4 Align the Anchor bolt loops with the PCB loops so the pin can pass through all four of the loops. If there is interference due to the height of the Anchor Bolt loops.

QMB TRANSITION

1.1 Remove the pin from the sloped end of the QMB Attachment Barrier

1.2 Fit the adapter plate over the hinge on the sloped end of the QMB Attachment Barrier.

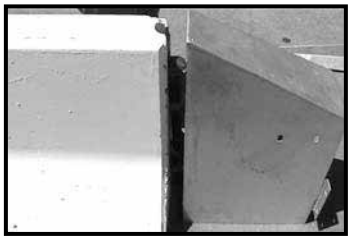
1.3 Secure the Hinge Plate Adapter to the Attachment Barrier by installing a QMB Hinge Pin.



1.4 Assemble and install the Strap Adapters around the Attachment QMB.

PCB TRANSITION

the Anchor Bolts by repeating step 1.1.



1.5 Install the pin down through the four loops.

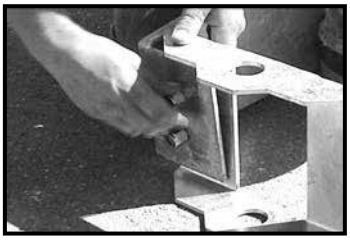
1.6 Tighten the nuts on the Anchor Bolts so that the adapter is tight against the PCB.

1.7 Tighten the four nuts on the Anchor Bolts to 15 ft-lbs (20 Nm). Then install a jam nut against the first nut with a torque of 40 ft-lbs. (55 Nm).

1.8 **OPTION:** In the event that the Taper Adapter is installed on a permanent concrete wall, mounting bolts must be installed. Place the Taper Adapter against the wall in its proper position.

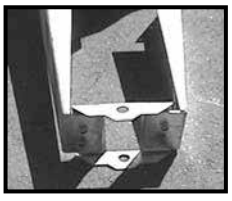
QMB TRANSITION

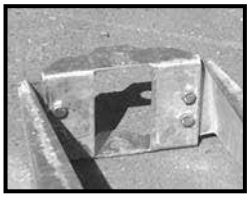
1.5 Attach the Adapter Straps to the Tie Strap Mount with the (4) 5/8" x 1 1/4" NC GRJ CADIIPLTD bolts, and (4) Nylock Nuts. **The (4) washers are spacers and must be installed between the strap and the Tie Strap Mount as shown.**



1.6 Attach the Nylock nuts on the ends of the bolts. Make sure to install the nuts on the outside of the strap as shown and hand tighten.

1.7 Repeat steps 1.5 and 1.6 on the other strap.





View of the pin end of the strap assembly after bolting up

PCB TRANSITION

concrete in the four spots that the anchor bolts would be located.

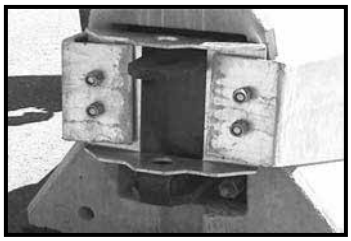
1.9 Drill four holes and install the ½" wedge anchor bolts. Torque the ½" nuts on the wedge anchor bolts to 40 ft-lbs (55 N-m).

1.10 Once the Taper Adapter has been securely attached (using either method mentioned above), install the Side Straps to both sides of the Taper Adapter. ATTACH LOOSELY, DO NOT TIGHTEN AT THIS TIME.

1.11 Attach the Hinge Plate Adapter to the Side Straps and Taper Adapter with eight (8) ½" x 1¼" (12 mm x 32 mm) NC GR 5 CADII PLTD bolts. FILL ALL HOLES. ALL TRANSITION COMPONENTS SHOULD BE LOOSELY INSTALLED AT THIS TIME. **Level the side straps and use the holes in the straps as a guide to mark the barrier where the bolt**

QMB TRANSITION

1.8 Place the strap around the sides of the QMB Attachment Barrier and over QMB hinge assembly. Keep the flat side of the strap on the top.



1.9 Place the Tie Strap Mount end of the strap assembly over the top of the QMB Attachment Barrier hinge as show above.

1.10 Install the Hinge Adapter Plate to the strap assembly with (6) ½" x 1 ½" NC GR5 CADIIPLTD bolts, (6) ½" Nylock Nuts and (12) ½" washers (washers must be used on all slotted holes). The nuts should be on the inside of the plate. After all of the bolts are installed, tighten the bolts with hand tools or an impact wrench.

PCB TRANSITION

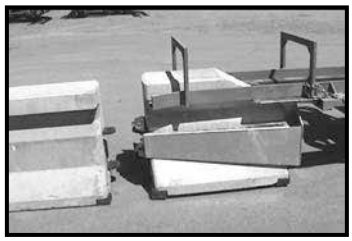
holes will be later drilled.

1.12 Now that the Strap Ends are at their final "level" position on the PCB, drill (4) ½" (12 mm) diameter holes, 3¼" (80 mm) deep in the side of the PCB. Install (4) ½" x 4¼" (12 mm x 108 mm) wedge anchor bolts. Place one ½" (12 mm) flat washer and nut on each anchor bolt. DO NOT TIGHTEN.

1.13 Remove the Hinge Plate Adapter that was loosely attached earlier.

1.14 Tighten the Side Strap nuts and bolts on the steel transition housing.

QMB TRANSITION



1.11 Use a suitable forklift and the QMB forklift handling tool to move the QMB Attachment Barrier into place.

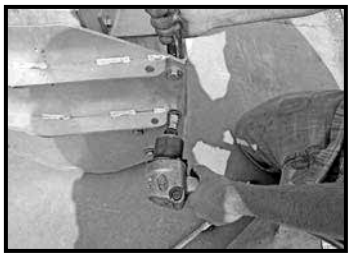
1.12 Insert the QMB pin.

1.13 Tap the top of the pin with a pry bar to ensure the pin is fully installed.

Fully installed QMB Attachment Barrier

PCB TRANSITION

1.15 Reinstall the Hinge Plate Adapter, installing bolts with washers right-to-left, top-to-bottom. Do not tighten until all bolts are installed. When reinstalling the plate, the use of a round tapered aligning bar is helpful when placed in the upper left bolt hole during reassembly.



1.16 Properly tighten ALL transition bolts.

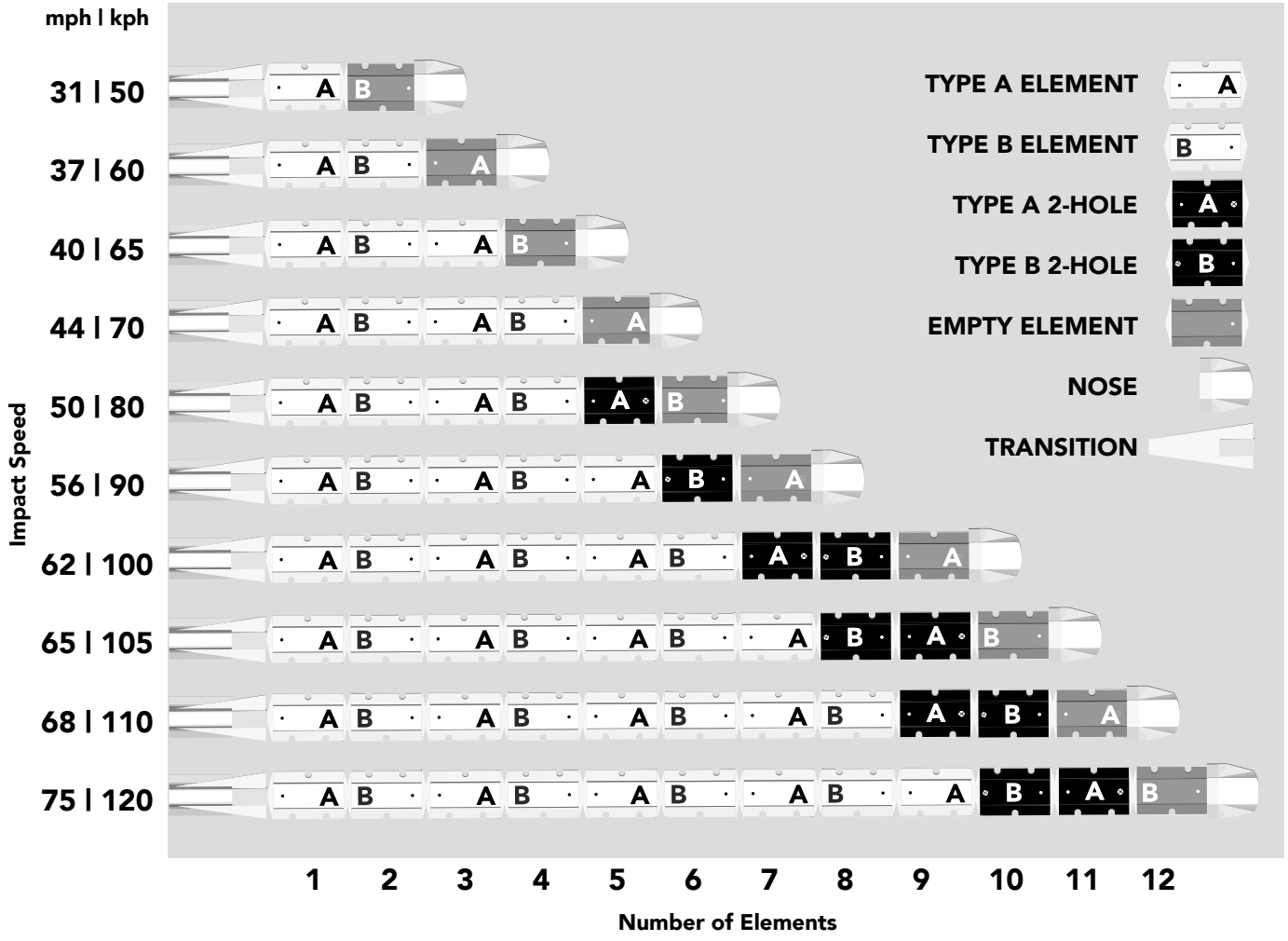
1.17 Tighten the anchors on the Side Straps

CAREFULLY CHOOSE THE REQUIRED SYSTEM

The ABSORB 350 Crash Cushion system has been fully designed and tested to comply with the evaluation requirements of the National Cooperative Highway Research Program Report 350 (NCHRP 350) for Test Levels 2 (70 km/h) and 3 (100 km/h). The Test Level 2 system contains five (5) Energy Absorbing Elements and the Test Level 3 system contains nine (9) Energy Absorbing Elements.

It is sometimes desirable to have a crash cushion that has an energy absorbing capacity that is less than Test Level 2, between test Level 2 and Test Level 3, or greater than Test Level 3. Therefore, the following table indicates the number of elements and the element placement configuration that would be required to absorb the kinetic energy of a 2000 kg (4400 lb.) vehicle impacting the front of the ABSORB 350 system, head-on and at the velocity indicated.

Roadside safety features such as crash cushions must be installed in accordance with the AASHTO Roadside Design Guide, state and local standards and in conformance with the manufacturer's instructions. Instructions from the manufacturer are available by contacting Barrier Systems, Inc., Customer Service Department at 1 (888) 800-3691 (Toll Free US) or 1 (707) 374-6800.



*Double hole elements must be cut on site, see page 14.

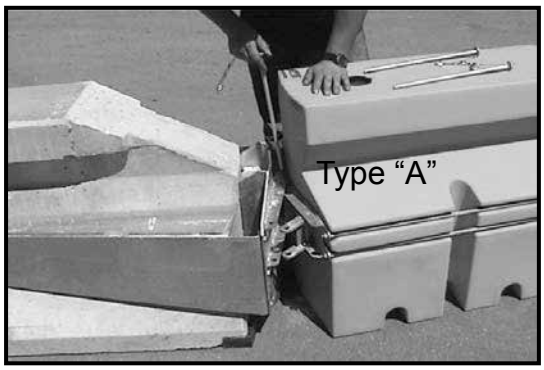
INSTALLATION INSTRUCTIONS FOR ENERGY ABSORBING ELEMENTS

PCB and QMB

INSTALL ENERGY ABSORBING ELEMENTS

There are two types of Energy Absorbing Elements and each type has a forward and rearward end. The forward end is considered the end that faces the Nose Piece. The rearward end faces the Concrete Barrier wall or QMB wall. The two types of elements are identified by the number of vertical indentations along each side in relation to the front and rear hinges. See a picture of the two different elements on page 4 and a hardware diagram on page 15.

When the Absorb 350 system is assembled, it is important to ensure that the two types of elements are **ALWAYS ASSEMBLED IN AN ALTERNATING FASHION** as shown in System Configuration Chart on Page 11. Thus, when you look down either side of the assembled system, you should see an alternating pattern of vertical indentations (i.e. two, one, two, one, etc.).



STEP 1
Install the first Energy Absorbing Element (Type “A”) to the PCB or QMB Hinge Plate Adapter by inserting the pin on each side of the hinge. Make sure that the harness clip on the pin is installed in the small hole located on the hinge next to the pin.


Install the pin with clip


Pin Configuration

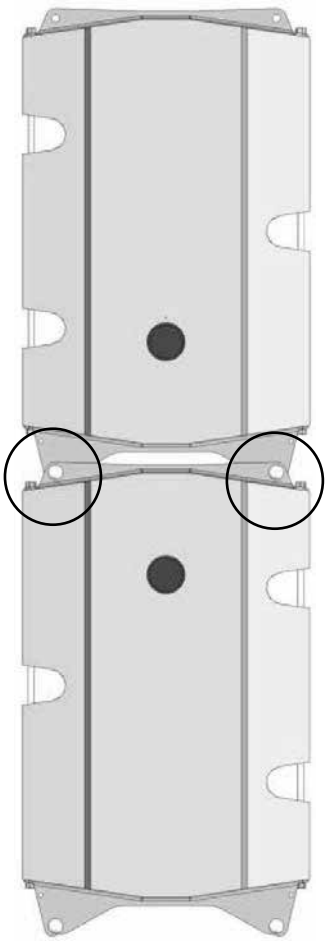
PART MODIFICATION NOTICE

PART: New ABSORB 350 Crash Cushion hinge hardware for Portable Concrete Barrier (PCB) installations.

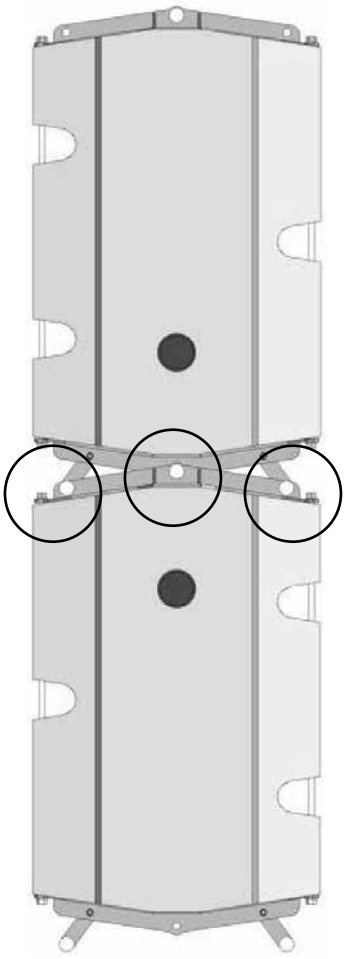
The 2-pin Hinge Hardware for the ABSORB 350 Crash Cushion is specifically designed for use on PCB installations (Figure 1). **The original hinge design can still be used for PCB or Quickchange Moveable Barrier (QMB) applications (Figure 2).** The difference between the old hardware and the new is that there are only two (2) pins used instead of three (3) between the Energy Absorbing Elements (EAE).

The new hardware can be used interchangeably for PCB systems (Figure 3) with the old design but the new design can not be used for QMB installations. The primary difference between the two designs is that the center pin is not necessary for PCB installations.

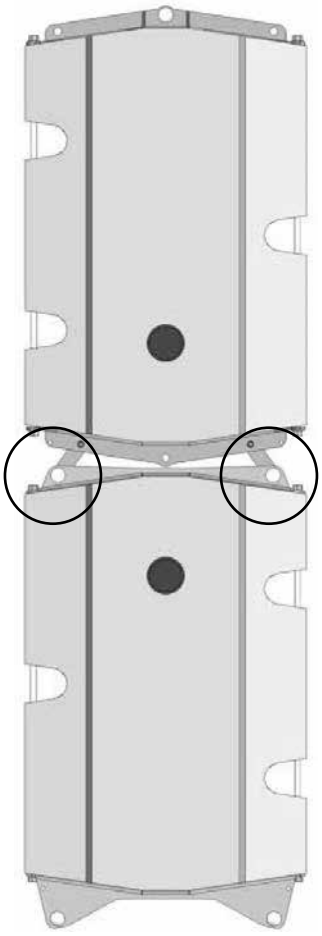
This new hardware has been crash tested and approved by FHWA for NHS use. To request documentation, contact BSI customer service at 888 800-3691 (US) or 707 374-6800.



FOR PCB USE ONLY

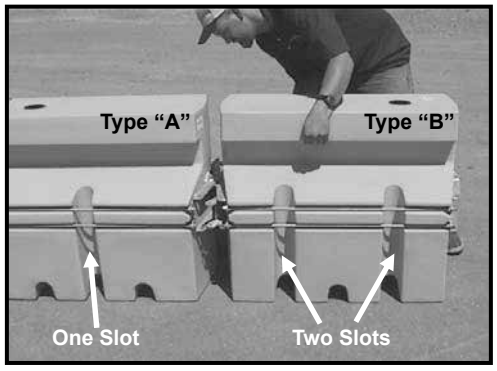


FOR PCB OR QMB USE



FOR PCB USE ONLY

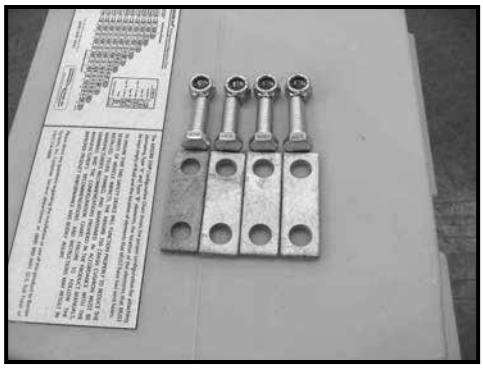
3-pin hinges can be used in conjunction with 2-pin hinges on PCB applications.



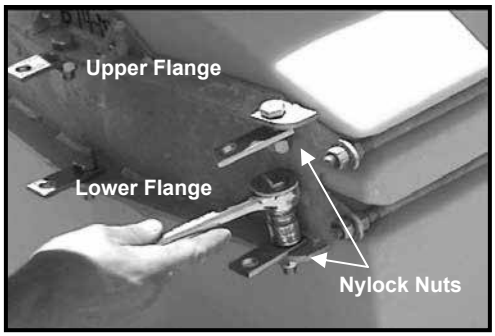
STEP 2
Continue attaching, alternating Type “A” and Type “B” Energy Absorbing Cartridges by repeating Step 1, until the desired system length is reached.

IMPORTANT – DOUBLE HOLE ELEMENTS

On 80 kph systems and above, some elements require two vent/fill holes. Refer to the system configuration chart to determine which elements require two vent/fill holes. The elements are not shipped with two holes; the second hole must be cut in these elements. Cut the second hole on the top of the other end of the element following the hole layout of the existing hole. (FOLLOW THE ELEMENT ORIENTATION EXACTLY AS SHOWN IN THE CONFIGURATION CHART IN APPENDIX B.) The additional evaporation caps for the new holes are shipped in the nose piece box.



STEP 3
Four tabs connect the final Energy Absorbing Element to either a PCB or QMB nose piece. These tabs are the mounting points for the nosepiece. The hardware is packed in the nose piece box.

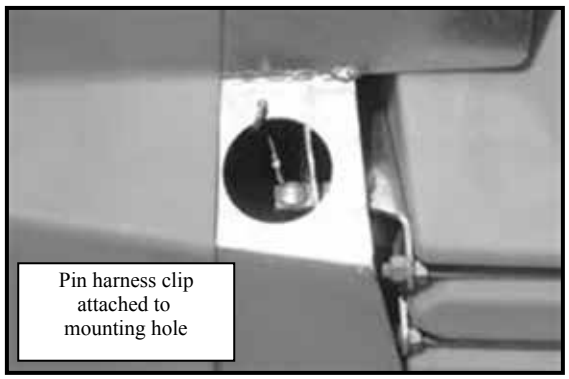


STEP 4
Attach the tabs as shown in the picture above. Before tightening the bolts, align the tabs so that a pin can be inserted from the top, through both of the holes. The upper tabs attach to the bottom side of the top hinge flange and the lower tabs attach to the top side of the bottom flange.


QMB Nose – Slide the corners over final element


PCB Nose – Slide corners over the final element

STEP 5
Align the tabs with the holes located on the inside of the Nose Piece. Slide the PCB or QMB Nose Piece over the hinge tabs. The nose piece will fit over the corners of the Energy Absorbing Element.



STEP 6
Attach the Nose Piece on the end of the final element with the two 3/8" x 15" (10mm x 381mm) pins that link the Nose Piece to the tabs on the hinge assembly. There are three (3) access holes in the Nose Piece (one on top, and one on each side). Use the two side access holes for the installation of these pins. After the pins are installed, attach the pin harness clips to the small mounting hole next to the access holes. It is very important that the Nose Piece does not become detached during an impact.

STEP 7
Before filling the elements with water, align the system elements with the downstream barrier.

STEP 8
Fill all of the Energy Absorbing Elements with water, except the final element. The element that attaches to the nosepiece **must not be filled with water**. Fill the remaining elements with water to a level that is within 2" (50 mm) from the top of the fill hole.

Example:
Only fill 4 elements for Test Level 2 (5 total elements)
Only fill 8 elements for Test Level 3 (9 total elements)

NOTE – FILLING THE ELEMENT ATTACHED TO THE NOSE PIECE WITH WATER WILL CAUSE THE SYSTEM TO PERFORM IMPROPERLY AND MAY CAUSE SERIOUS BODILY INJURY.

In regions where the water filled ABSORB 350 elements could become frozen, proper antifreeze agents should be used. Care should be taken to ensure that proper antifreeze agents are used in accordance with local regulations, environmental concerns and ensuring that any post impact liquid on the road surface does not constitute an undue hazard to adjacent motorists.
Some customers have indicated that common deicing and dust control chemicals that are used on the highway make excellent choices for antifreeze agents. These include:

- Calcium Chloride ($CaCl_2$)
- Calcium Magnesium Acetate (CMA)
- Potassium Acetate (KAc)

After you have selected a state approved product for an antifreeze agent, we recommend contacting your chemical manufacturer to verify the percent of purity and to calculate the amount of chemical needed to achieve the temperature desired.

The ABSORB 350 elements should be inspected regularly to ensure that the elements that are intended to contain water (or antifreeze fluid) are kept at adequate fill levels.

STEP 9
Install the Evaporation Prevention Cap into the top of each plastic element. The cap needs to be securely pushed down to prevent evaporation. In addition, the tie strap should be securely fastened through the hole in the cap and the hole located next to the cap on the top of the element.

INSPECTION
THE METAL COMPONENTS AND FASTENERS OF THE SYSTEM SHOULD BE PERIODICALLY INSPECTED TO ENSURE THAT THE SYSTEM REMAINS INTACT AND ABLE TO PERFORM IN A SAFE AND EFFECTIVE MANNER.

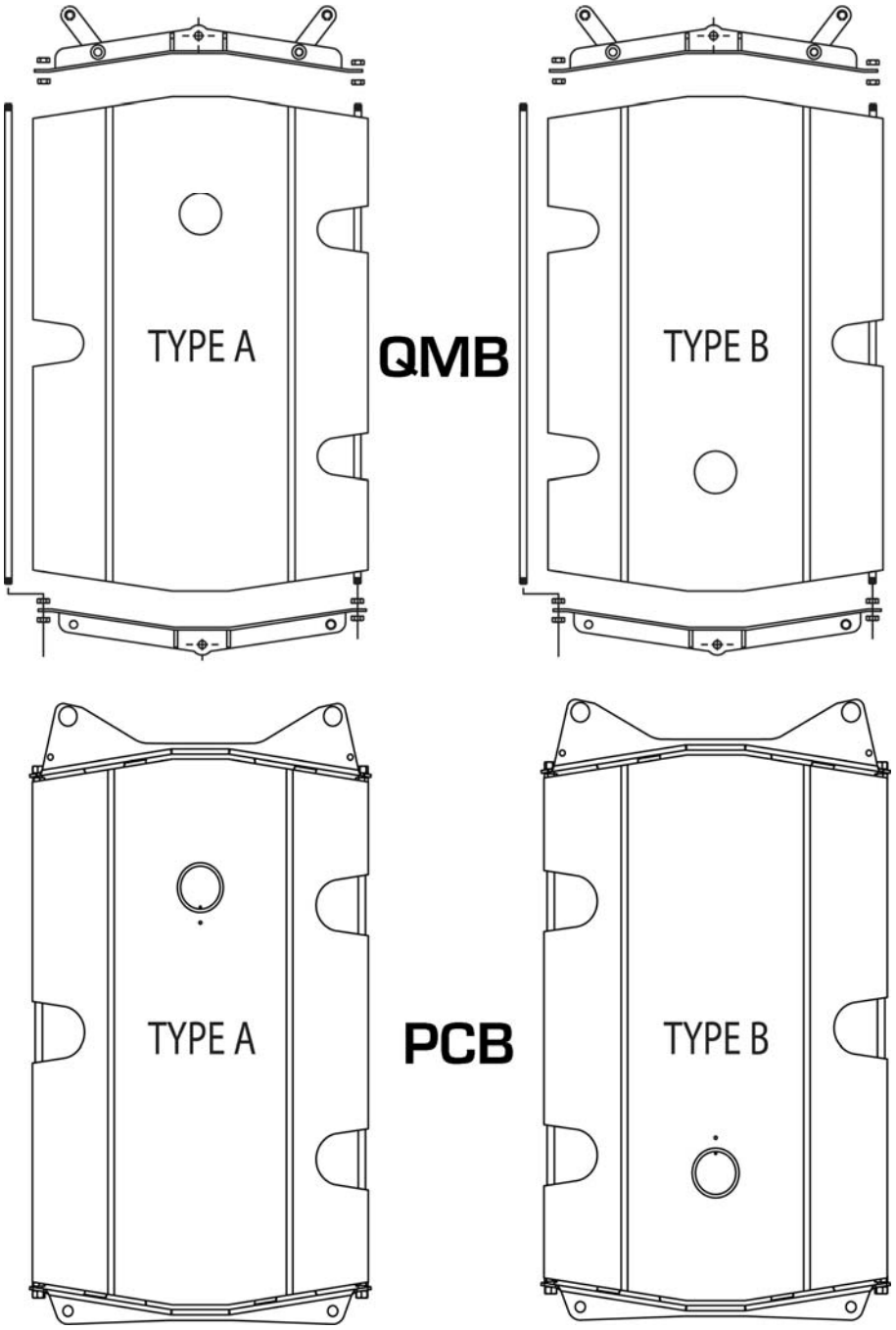
REPLACEMENT OF DAMAGED UNITS

Any component within the system that becomes damaged should be replaced immediately.

CONVERTING A TYPE “A” ENERGY ABSORBING ELEMENT INTO A TYPE “B” ELEMENT

Type A and Type B elements must be installed according to the configuration chart in Appendix B. If necessary, a Type “A” element can be converted to a Type “B” element by simply reversing the plastic within the hinge system hardware.

ABSORB 350 Element Assembly



PREFACE

The Barrier Systems, Inc. (BSI), ABSORB 350 crash cushion system incorporates the newest roadside safety materials and engineering processes.

As with any roadside safety device, the ABSORB 350 system must be properly maintained to insure proper performance. Thoroughly review and fully understand the maintenance instructions and product limitations before performing any maintenance. An instructional video is available from BSI to help explain the general requirements. Do not begin any maintenance operation without the proper plans and tools. For further guidance, refer to the ABSORB 350 Installation portion of this manual.

If you need additional information, or have questions about the ABSORB 350 Crash Cushion, please call the Lindsay Transportation Solutions Customer Service Department at (888) 800-3691 (U.S. toll free) or (707) 374-6800.

INTRODUCTION

The ABSORB 350 system has been tested to meet the rigorous requirements of NCHRP Report 350, Test Levels 2 and 3. The systems will be provided in lengths and capacities for both low speed and high speed applications.

The ABSORB 350 system is a non-redirective, gating, crash cushion, and is ideally suited for narrow hazards such as portable, permanent or moveable concrete barrier. Ease of installation, numerous transition options, low maintenance requirements, and reusability of system components make the ABSORB 350 system ideal for treating many roadside hazards.

Non-Redirective, gating, crash cushions are highway safety devices whose primary function is to improve the safety for occupants of errant vehicles that impact the end of rigid or semi-rigid barriers or fixed roadside hazards by absorbing the inertia of vehicle impact or by allowing controlled penetration of the vehicle. These devices are designed to safely decelerate errant vehicles. These types of systems are typically applied to locations where head-on and angled impacts are likely to occur and it is not necessarily desirable to have post impact trajectories on the impact side of the system.

Placement and use of the ABSORB 350 system should be accomplished in accordance with the guidelines and recommendations set forth in the "AASHTO Roadside Design Guide," FHWA memoranda and other state and local standards.

IMPORTANT INFORMATION

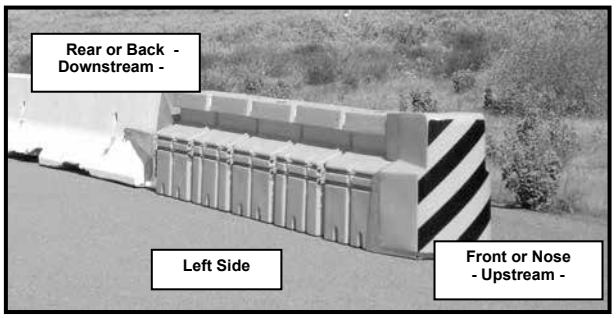
The ABSORB 350 crash cushion must be installed properly to maximize the systems ability to protect errant motorists that impact the system. Designers, installers and people that maintain the system should thoroughly understand the manufacturer's instructions prior to performing any necessary maintenance or repair work. Key information is provided in this Maintenance Manual and important additional information is in the Installation Manual. If these documents are not available, or if there are any questions regarding the proper placement or installation of the ABSORB 350 crash cushion, contact Barrier Systems, Inc., Customer Service at U.S. toll free (888) 800-3691 or (707) 374-6800.

SYSTEM OVERVIEW

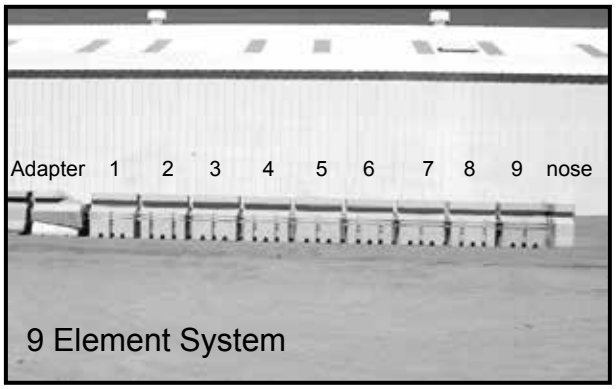
The ABSORB 350 system is designed and constructed to provide acceptable structural adequacy, minimal occupant risk and safe vehicle trajectory as set forth in NCHRP 350 for non-redirective, gating, crash cushions. The ABSORB 350 system is designed to shield the ends of median barriers and other narrow fixed objects likely to be struck head-on, by absorbing and dissipating the inertia of impacting vehicles. ABSORB 350 utilizes disposable water filled Energy Absorbing Elements (EAEs) to absorb the inertia of the impacting vehicle. Only the Energy Absorbing Elements are expended after most head-on impacts.

Sign Conventions

The picture of the ABSORB 350 system below is labeled to show the descriptive terms that will be used throughout this manual.



Element Counting Convention



The picture of the ABSORB 350 system above is labeled to show how the elements are numbered throughout this manual.

Design Considerations

The ABSORB 350 system is a non-redirective, gating system that has been fully tested in conformance with NCHRP Report 350 and approved by the U. S. DOT Federal Highway Administration as well as several countries outside of the U.S. Non-redirective, gating, crash cushions are frequently used at locations where it is desirable for the vehicle post impact trajectories to be behind the system. If it is desirable to have the majority of post impact vehicle trajectories on the impact side of the system, a Redirective, non-gating, crash cushion should be considered.

This section will address several of the other key issues that should be considered in deciding where and how to use the ABSORB 350 crash cushion.

System Length and Width

The length of the ABSORB 350 crash cushion system is determined by the required capacity. The width of the system is 24” (61cm).

System Capacity

The ABSORB 350 crash cushion is available in variable lengths to accommodate frontal impact velocities higher and lower than required in NCHRP Report 350. Appendix B contains a chart that shows the number of options available, the frontal impact speed capacity and element configurations.

Types of Installations

The ABSORB 350 crash cushion can be installed on permanent concrete barrier, portable concrete barrier, portable steel barrier and moveable barrier.

Foundation Options and Considerations

The ABSORB 350 system does not need to be attached to a foundation and can be installed on top of concrete, asphalt or any surface capable of bearing the weight of the system.

Cross slopes of up to 8% (5 degrees or 1:12 slope) can be accommodated with the standard hardware and with the instructions provided with the system. If there are cross slopes in excess of 8%, contact

Barrier Systems, Inc., Customer Service to obtain engineering advice and assistance.

Transition Advisory

The ABSORB 350 crash cushion was designed to be able to used with permanent, portable, or moveable concrete barrier and portable steel barrier. Special care should be taken to ensure that the type of transition system chosen properly addresses the direction of all vehicles that will be exposed to the system.

Other Site Conditions and Considerations

There are numerous other conditions that should be taken into consideration when selecting and locating crash cushions. The majority of these are addressed in the "AASHTO Roadside Design Guide" and in memoranda from the Federal Highway Administration and state Departments of Transportation. These should always be taken into consideration when selecting and locating crash cushions.

A few of the typical considerations are as follows:

- All curbs, islands and elevated objects greater than 4 inches (100 mm) high that would be beneath, beside or less than 50 feet (15 m) in front of a ABSORB 350 crash cushion should be removed prior to installation.

- Ensure that all drainage inlets or structures, junction boxes, expansion joints, sign supports, delineators or any other element that is close to the installation site of the ABSORB 350 system, cannot interfere with the proper operation of the system.

Limitations and Warnings

The ABSORB 350 Non-Redirective, Gating, Crash Cushion has been designed and tested to perform in accordance with the criteria set forth in the National Cooperative Highway Research Program Report No. 350 (NCHRP 350) for devices in this specific category.

It is very important to note that non-redirective crash cushions should be applied to locations where there is not a need for redirection of impacting vehicles and where there is an adequate clear zone adjacent to the system. Other products that have been approved for use in this operational category include sand barrel arrays.

The ABSORB 350 system should be installed and maintained in accordance with the instructions in this Installation and Maintenance manual. Failure to install or maintain the system in accordance with these instructions could result in the system not performing in accordance with the product specifications and severe bodily injury to errant motorists that impact the system.

The system should be filled with a proper fluid and delineated in accordance with the instructions in the Installation and Maintenance Manual, federal, state and local requirements. The federal, state and local requirements will always supercede the instructions in the manual regarding delineation and the type of fluid to be used in the elements of the ABSORB 350 system.

The ABSORB 350 system should always be installed on a firm surface that would prevent the system from becoming embedded in the surface over long periods of time. Debris should be kept clear of the system and no foreign objects should be in close proximity or on top of the system during operation.

The impact performance of the crash cushion systems described in this document have been conducted under controlled conditions. Barrier Systems, Inc. (BSI) does not represent nor warrant that the results of those controlled conditions would necessarily avoid injury to persons or property. BSI expressly disclaims any warranty or liability for claims arising by reasons of death or personal injury or damage to property resulting from any impact, collision or harmful contact with the crash cushion system or nearby hazards or objects, by any vehicle, objects or persons.

LIMITED WARRANTY

Lindsay Transportation Solutions, Inc. “LTS” (formerly Barrier Systems) has tested the impact performance of its barriers and crash cushion systems, and other highway safety hardware under controlled conditions, however, LTS does not represent nor warrant that the results of those controlled conditions would necessarily avoid injury to persons or property. LTS EXPRESSLY DISCLAIMS ANY WARRANTY OR LIABILITY FOR CLAIMS ARISING BY REASONS OF DEATH OR PERSONAL INJURY OR DAMAGE TO PROPERTY RESULTING FROM ANY IMPACT, COLLISION OR HARMFUL CONTACT WITH THE PRODUCTS OR NEARBY HAZARDS OR OBJECTS BY ANY VEHICLE, OBJECTS OR PERSONS.

LTS warrants that any product or component part manufactured by LTS will be free from defects in material or workmanship. LTS will replace free of cost any Product or component part manufactured by LTS that contains such a defect.

THE FOREGOING WARRANTY IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES NOT EXPRESSLY SET FORTH HEREIN, WHETHER EXPRESS OR IMPLIED BY OPERATION OF LAW OR OTHERWISE, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

LTS’ LIABILITY UNDER THIS WARRANTY IS EXPRESSLY LIMITED TO REPLACEMENT FREE OF COST (IN THE FORM AND UNDER THE TERMS ORIGINALLY SHIPPED), OR TO REPAIR OR TO MANUFACTURE BY LTS, PRODUCTS OR PARTS NOT COMPLYING WITH LTS SPECIFICATIONS, OR, AT LTS’ ELECTION, TO THE REPAYMENT OF AN AMOUNT EQUAL TO THE PURCHASE PRICE OF SUCH PRODUCTS OR PARTS, WHETHER SUCH CLAIMS ARE FOR BREACH OF WARRANTY OR NEGLIGENCE. LTS SHALL NOT BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL LOSSES, DAMAGES OR EXPENSES OF ANY KIND, INCLUDING, WITHOUT LIMITATION, ANY SUCH LOSSES, DAMAGES OR EXPENSES ARISING DIRECTLY OR INDIRECTLY FROM THE SALE, HANDLING OR USE OF THE PRODUCTS FROM ANY OTHER CAUSE RELATING THERETO, OR FROM PERSONAL INJURY OR LOSS OF PROFIT.

Any claim by the Buyer with reference to Products sold hereunder for any cause shall be deemed waived by the Buyer unless LTS is notified in writing, in the case of defects apparent on visual inspection,within ninety (90) days from the delivery date, or, in the case of defects not apparent on visual

inspection, within twelve (12) months from the said delivery date. Products claimed to be defective may be returned prepaid to LTS’ plant for inspection in accordance with return shipping instructions that

LTS shall furnish to the Buyer forthwith upon receipt of the Buyer’s notice of claim. If the claim is established, LTS will reimburse that Buyer for all carriage costs incurred hereunder.

The forgoing warranty benefits shall not apply to (i) any Products that have been subject to improper storage, accident, misuse or unauthorized alterations, or that have not been installed, operated and maintained in accordance with approved procedures and (ii) any components manufactured by the Buyer.

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For additional information regarding this product, please contact:

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barriersystemsinc.com

Inspection / Drive-By

The frequency of Drive-By inspections is dependent on the traffic volume and the impact history of the system. ***Drive-By inspections are recommended at least monthly.***

1) The inspector should be moving at a speed that is sufficiently slow enough to detect impact or environmental damage (debris). If any damage is observed, a Hands-On inspection is warranted.

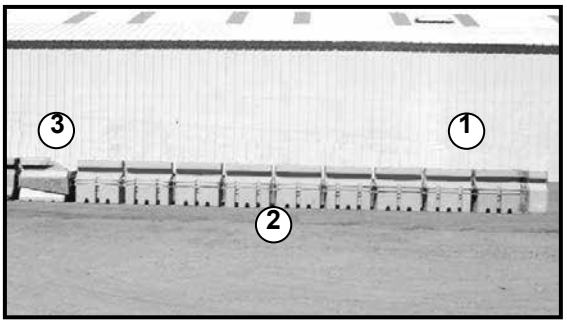
2) Make sure that all of the elements are present and that there is no debris lodged between the elements.

3) If delineation has been applied to the nose cover, make sure that it is still properly applied and visible.

4) If the system appears to have been impacted in any way (scrapes, paint marks, etc.) a Hands-On inspection should be made.

NOTE: It is important to keep a logbook of all Drive-By inspections for each installed system. Record the date of the inspection and observed condition of the system.

1. Look for tire or paint marks on front, side and transition.



2. Look for debris between elements (tire, garbage, etc).

3. Look for transition damage.

Although there may be no obvious damage, paint marks along the side would indicate an impact and the need for a hands-on inspection.

Inspection / Hands-On

The frequency of Hands-On inspections is dependant on the traffic volume and the impact history of the system. ***Hands-On inspections are recommended at least yearly.***

1) Check that all of the elements are straight.

2) Check in the spaces between the Energy Absorbing Elements (EAEs) to remove any debris that may have accumulated.

3) Check the water level in the elements. The water should be within 2" of the top of the element. **THERE SHOULD BE <u>NO</u> WATER IN THE ELEMENT ATTACHED TO THE NOSE PIECE.**

4) Check the condition of and the placement of all Energy Absorbing Elements. Replace any damaged Cartridges. Refer to the chart in Appendix "B" for proper placement.

NOTE: It is important to keep a log book of all Hands-On inspections for each installed system. Record the date of inspection, the observed condition of the system and any replaced items.

Post Impact Inspection – Repairs

After an impact, the system must be thoroughly inspected to determine which parts can be reused and which parts will need to be replaced. The system must be repaired to its original condition to operate properly during the next impact.

1) If the system has sustained an impact, detach the damaged elements by removing the two side pins and properly discard. Replace the damaged element with the same type of element Type "A" or "B".

   NOTE: Due to the possibility of reduced performance, any elements with bent side rods should be replaced.

2) Ensure that the system is re-installed in the proper configuration by referencing the system configuration chart in Appendix "B".

3) Inspect for damage to the bolts that attach the transition. Remove and replace any damaged bolts.

4) Inspect the Nose Piece for damage. Repair or replace the Nose Piece if there is damage, and apply the proper delineation.

5) Make sure that all of the pins are in place on both sides of the system.

ABSORB 350® Crash Cushion APPENDIX

APPENDIX A Ordering Instructions

Make a list of the needed replacement parts. Call BSI Customer Service at U.S. toll free (888) 800-3691 or (707) 374-6800.

PCB System	Part #
Nose Piece Assembly	B010825
Transition to PCB	K001056
Type A Element	B030660
Type B Element	B030661
Hinge Pin, Long	A010420

QMB System	Part #
Nose Piece Assembly	B991204
Transition to QMB	B000419
Type A Element	B000303
Type B Element	B000708
Hinge Pin, Long	A010420

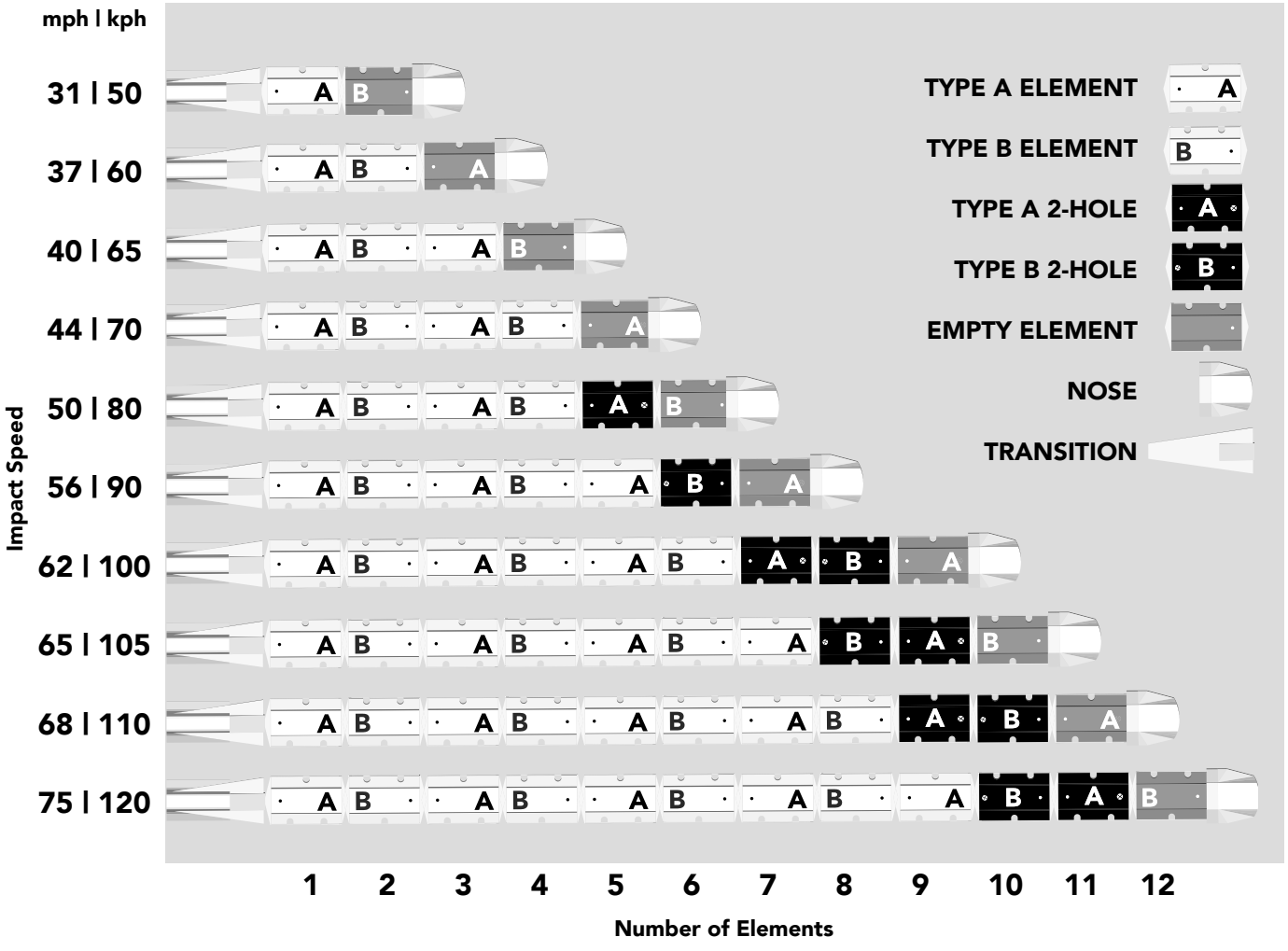
ABSORB 350® Crash Cushion APPENDIX

APPENDIX B System Configurations

The ABSORB 350 Crash Cushion system has been fully designed and tested to comply with the evaluation requirements of the National Cooperative Highway Research Program Report 350 (NCHRP 350) for Test Levels 2 (70 km/h) and 3 (100 km/h). The Test Level 2 system contains five (5) Energy Absorbing Elements (EAB) and the Test Level 3 system contains nine (9) Energy Absorbing Elements.

It is sometimes desirable to have a crash cushion that has an energy absorbing capacity that is less than Test Level 2, between test Level 2 and Test Level 3, or greater than Test Level 3. Therefore, the following table indicates the number of elements and the element placement configuration that would be required to absorb the kinetic energy of a 2000 kg (4400 lb.) vehicle impacting the front of the ABSORB 350 system, head-on and at the velocity indicated.

Roadside safety features such as crash cushions must be installed in accordance with the AASHTO Roadside Design Guide, state and local standards and in conformance with the manufacturer's instructions. Instructions from the manufacturer are available by contacting Barrier Systems, Inc., Customer Service Department at 1 (888) 800-3691 (Toll Free US) or 1 (707) 374-6800.



*Double hole elements must be cut on site, see page 14.

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