ACZ-350™ System

Product Description
Instructional Manual

Part No. 115663B
Rev. E Sept 2011
Important: These instructions are to be used only in conjunction with the installation, maintenance, and repair of the ACZ-350™ System. These instructions are for standard installations specified by the appropriate highway authority only. In the event the specified system installation, maintenance, or repair would require a deviation from standard installation parameters, contact the appropriate highway authority engineer. This system has been accepted for use by the Federal Highway Administration for use on the national highway system under strict criteria utilized by that agency. Energy Absorption Systems representatives are available for consultation if required.

This Manual must be available to the worker at all times. For additional copies, contact Energy Absorption Systems at 888-323-6374 (312-467-6750 outside USA)

The instructions contained in this Manual supersede all previous information and manuals. All information, illustrations, and specifications in this Manual are based on the latest ACZ-350™ System information available to Energy Absorption Systems at the time of printing. We reserve the right to make changes at any time. Please contact Energy Absorption Systems to confirm that you are referring to the most current instructions.
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Customer Service Contacts

Energy Absorption Systems (a Trinity Industries, Inc. company) is committed to the highest level of customer service. Feedback regarding the ACZ-350™ System, its installation procedures, supporting documentation, and performance is always welcome. Our goal is to assist the appropriate highway authority in their efforts to make the national highway system safer. Additional information can be obtained by calling the telephone numbers below:

**Energy Absorption Systems:**

<table>
<thead>
<tr>
<th></th>
<th>Telephone:</th>
<th>Fax:</th>
<th>E-mail:</th>
<th>Internet:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telephone:</td>
<td>(888) 323-6374 (USA Only)</td>
<td>(800) 770-6755 (USA Only)</td>
<td><a href="mailto:customerservice@energyabsorption.com">customerservice@energyabsorption.com</a></td>
<td><a href="http://www.energyabsorption.com/">http://www.energyabsorption.com/</a></td>
</tr>
<tr>
<td></td>
<td>(312) 467-6750 (USA or International)</td>
<td>(916) 645-3495 (USA or International)</td>
<td></td>
<td><a href="http://www.highwayguardrail.com/">http://www.highwayguardrail.com/</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><a href="http://www.trin.net/">http://www.trin.net/</a></td>
</tr>
</tbody>
</table>

Important Introductory Notes

Proper deployment, installation location design, and future maintenance of the ACZ-350™ System are essential to assure maximum performance under accepted criteria. Take the time to review this manual thoroughly before performing the necessary work. Do not attempt to install any crash cushion without the proper plans and specifications from the highway authority and installation manual from the manufacturer. If you need additional information, or have questions about the ACZ-350™ System, please contact the highway authority that has planned and specified this installation and, if needed, call Energy Absorption Systems' Customer Service Department.

System Overview

The ACZ-350™ System is a highly portable and FHWA accepted crash cushion, especially suited for use as a temporary barrier in highway construction zones where the chance of high angle, high speed impacts is low.

The ACZ-350™ System provides several unique advantages over traditional crash cushions:
- Protects permanent or temporary, steel or concrete barriers
- Effectively contains errant vehicles within FHWA accepted limits
- Quick and easy deployment and retrieval
- Lightweight
- Economical
- Easy cleanup
- Narrow profile

The ACZ-350™ System has been thoroughly tested to the appropriate National Cooperative Highway Research Program Report 350 (NCHRP 350) crash testing criteria and was accepted for use on the national highway system by the FHWA.
**Conformance**
The ACZ-350™ System has been tested to and conforms to the current guidelines used by the Federal Highway Administration (FHWA) as recommended in:


**Function**
The ACZ-350™ System is designed to perform as a narrow, non-redirecting crash cushion to shield the blunt ends of both permanent and variable length Portable Concrete Median Barriers (PCMB), as well as FHWA accepted steel median barrier systems such as the Vulcan® Barrier, when impacted under appropriate NCHRP 350 criteria.

Crash testing under NCHRP 350 has demonstrated that impacting vehicles are brought to a safe and controlled stop when the System is struck on the nose within those criteria. The ACZ-350™ System absorbs impact energy and cushions vehicular impacts while significantly reducing the risk to occupants of the impacting vehicle within the 350 criteria.

![Caution: Proper impact performance will only be achieved if all sections are properly positioned. These sections are not to be mixed with similar shaped barrier sections as those configurations have not been accepted by FHWA.]

**End Treatment**
The ACZ-350™ System has been crash tested and meets NCHRP TL-2 (75 km/h [44 mph]) and TL-3 (100 km/h [62 mph]) Non-Redirective Gating conditions when installed in accordance with the manufacturer's instructions. The TL-2 System consists of two water-filled Barrier segments and the TL-3 System contains four water-filled Barrier segments.

Selection, and placement of the ACZ-350™ System, and design of installation, should conform to applicable guidelines in:


Federal, State, and local criteria governing the ACZ-350™ System conformance may vary. Consult local FHWA and State Department of Transportation representatives prior to installation.
Construction

The ACZ-350™ System consists of a sheet metal nose, two or four water-filled plastic shell Barrier segments, and a steel transition pinned together to act as an end treatment. The nose is constructed of light gauge steel and connects directly to the front-most water-filled segment. The water-filled segments are constructed of a lightweight polyethylene plastic shell designed to accept water ballast. This durable, recyclable material resists cracking, breakage and corrosion under harsh environmental conditions.

Each segment is also equipped with an external, top-mounted steel stiffener which is rigidly fixed to each respective segment. For a four-segment system, the front two segments do not contain an internal steel frame or external, side-mounted laminated steel straps. In contrast, the two-segment system, or last two segments of a four segment system come equipped with an internal steel frame as well as external side-mounted steel laminated straps. A heavy-duty non-crushable steel transition completes the system by connecting the last water-filled segment to the blunt end of the downstream barrier, whether a PCMB or Vulcan® barrier.

The total length of a four-segment TL-3 ACZ-350™ System is 9.6 meters (31'-7"). The total length of a two-segment TL-2 ACZ-350™ is 5.6 meters (18'-4"). In bi-directional traffic applications, there are no rigid exposed vehicle snag points for traffic traveling from the reverse direction.

The ends of each water-filled section are constructed with knuckles that interlock with those of other segments. The end knuckles are vertically aligned to accept a steel connecting pin. The pin securely joins the sections and the top steel stiffener for maximum impact performance.

The ACZ-350™ water-filled segments are constructed in a unique shape. The inward sloping ribbed side walls have been shown through NCHRP crash testing to resist penetration, vaulting and under-riding.

Sections are stackable when empty to reduce shipping and storage space. Each ACZ-350™ segment is constructed with fork lift ports to allow mechanical lifting if desired. Large fill openings are provided to allow quick filling and a rapid release gate valve for draining the water ballast. A permanent fill level indicator in the top of each section allows quick verification that the section is adequately full.

Important: Read safety instructions thoroughly and follow the assembly directions and suggested safe practices before installing, maintaining, or repairing the ACZ-350™ System. Failure to follow this warning can result in serious injury or death to the worker and/or bystanders. It further compromises the acceptance of this system by the FHWA. Please keep these instructions for later use.

Warning: Ensure that all of the ACZ-350™ System Warnings, Cautions, and Important statements within the ACZ-350™ System manual are completely followed. Failure to follow this warning could result in serious injury or death in the event of a collision.
Recommended Safety Rules for Assembly and Installation

* Important Safety Instructions *

This Manual must be kept in a location where it is readily available to persons who install, maintain, or repair the ACZ-350™ System. Additional copies of this Manual are available from Energy Absorption Systems by calling 888-323-6374 (312-467-6750 outside USA). Please contact Energy Absorption Systems if you have any questions concerning the information in this Manual or about the ACZ-350™ System.

Always use appropriate safety precautions when operating power equipment, mixing chemicals, and when moving heavy equipment or the ACZ-350™ components. Gloves, safety goggles, and back protection should be used.

Safety measures incorporating traffic control devices must be used to provide safety for personnel while at the installation, maintenance, or repairs site.

Safety Symbols

This section describes the safety symbol that appears in the ACZ-350™ System Manual. Read the Manual for complete safety, assembly, operating, maintenance, repair, and service information.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Alert Symbol</td>
<td>Indicates Danger, Warning, or Caution. Failure to read and follow the Danger, Warning, Safety, or Caution indicators could result in serious injury or death to the workers and/or bystanders.</td>
</tr>
</tbody>
</table>
Warning and Cautions
Read all instructions before installing, maintaining, or repairing the ACZ-350™ System.

Warning: Do not assemble, install, maintain, or repair the ACZ-350™ System until you have read this Manual thoroughly and completely understand it. Ensure that all Warnings, Cautions and Important statements within the manual are completely followed. Please call Energy Absorption Systems at 888-323-6374 (312-467-6750 outside USA) if you do not understand these instructions. Failure to follow this warning could result in serious injury or death in the event of a collision.

Warning: Safety measures incorporating traffic control devices must be used to protect all personnel while at the installation, maintenance or repair site. Failure to follow this warning could result in serious injury or death in the event of a collision.

Warning: Be sure adequate time is available for complete installation, maintenance, or repair before beginning the installation, maintenance, or repair process. Failure to follow this warning could result in serious injury or death in the event of a collision.

Warning: Use only Energy Absorption Systems’ parts for installing, maintaining, or repairing the ACZ-350™ System. Installation, maintenance, or repairs using unauthorized accessories is strictly prohibited. Failure to follow this warning will compromise the acceptance of this System by the FHWA and could result in serious injury or death in the event of a vehicle impact with a NONAPPROVED system.

Warning: Do NOT modify the ACZ-350™ System in any way. Failure to follow this warning could result in serious injury or death in the event of a collision.

Warning: Ensure that the ACZ-350™ System and delineation used meet all federal, state, specifying agency, and local specifications. Failure to follow this warning could result in serious injury or death in the event of a collision.

Warning: Ensure that your installation meets all appropriate Manual on Uniform Traffic Control Devices (MUTCD) and local standards. Failure to follow this warning could result in serious injury or death in the event of a collision.
Warning: Ensure that there is proper site grading for ACZ-350™ System placement as dictated by the state, specifying agency, pursuant to Federal Highway Administration (FHWA) acceptance. Failure to follow this warning could result in serious injury or death in the event of a collision.

Limitations and Warnings
The ACZ-350™ System has been successfully tested, evaluated, and accepted per the NCHRP 350 guidelines (NCHRP 350) for Test Level 2 (TL-2) and Test Level 3 (TL-3), End Treatment. The selected test matrix impact conditions recommended in this guideline are intended to encompass the majority, but not all, of the possible in-service collisions.

Properly deployed, the ACZ-350™ System has shown in crash testing under NCHRP 350 criteria to dissipate the kinetic energy of errant vehicles. (See the Installation and Retrieval sections of this manual.)

Vehicles: Small car, large sedan, or pickup truck

Speed: TL-3: 100 km/h [62 mph]
       TL-2: 70 km/h [45 mph]

Mass:  820 and 2000 kg [1808 and 4409 lb]

Angle: The ACZ-350™ System is a non-redirective crash cushion. It is recommended that the ACZ-350™ System be used to protect concrete or steel barriers at sites where the chance of high angle, high speed impacts is low. If these types of angled impacts may occur, a redirective crash cushion, such as the QuadGuard® System, should be installed instead.

Impacts that exceed the performance level of the product may not result in acceptable crash performance as described in NCHRP 350 relative to structural adequacy, occupant risk, and vehicle trajectory evaluation factors.

Proper maintenance of the ACZ-350™ System is essential to assure maximum performance (See the Maintenance and Repair section of this manual).
Know Your ACZ-350™ System

For specific installation, maintenance, or repair details refer to the state or specifying agency’s standard drawing(s) and/or Energy Absorption Systems standard layout drawings.

**FEATURES:**
- CONNECTABLE & INTERLOCKING
- STACKABLE
- LARGE FILL OPENINGS
- EASY CLEAN-UP
- NARROW PROFILE
- MINIMUM INTRUSION
- LOW COST
- QUICK & EASY TO MOVE

**CAPACITY:**
- 550L [145 GAL.] - EACH SEGMENT
- 2200L [580 GAL.] - TOTAL SYSTEM (TL-3)

**WEIGHT:**
- 65KG [140 LBS] EMPTY-NO STRAPS - EACH PLASTIC BARRIER
- MAX. 156KG [344 LBS] EMPTY-WITH STRAPS - REAR BAY ASSEMBLY
- 610KG [1350 LBS] FULL - EACH PLASTIC BARRIER

**COLOR:**
- ORANGE
- WORK ZONE SAFETY YELLOW
- WHITE

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**Figure 1, TL-3 ACZ-350™ Components**
Figure 2, ACZ-350™ Dimensions
Special Site Considerations
A traffic control plan, in detail appropriate to the complexity of the work project, should be prepared and understood by all parties before the ACZ-350™ System is deployed in a work zone. Some special site considerations are:

1. What is the design speed at the site?
The TL-3 ACZ-350™ System is capable of handling impacts from vehicles up to 2000 kg [4400 lb] at speeds up to 100 km/h [62 mph] at angles up to 20 degrees. A shorter TL-2 system may be allowed in areas with lower design speeds.

2. What foundation will the barrier be deployed on and what is its slope?
The ACZ-350™ System may be deployed on various surfaces. The existence of cross slopes greater than 5%, longitudinal slope greater than 5%, or curbs may not meet NCHRP-350 criteria.

3. Can the water ballast be drained at the site?
If not, provisions must be made to either siphon out the water ballast or use a forklift to move full sections to a location where they can be drained.

4. Will the Barrier segment be used in a climate where the water ballast may freeze?
The ACZ-350™ System may not meet the criteria of NCHRP 350 if the water ballast is allowed to freeze. Depending on anticipated climate conditions, an appropriate antifreeze agent may need to be selected and added in appropriate quantities to each water-filled segment to prevent freezing. See Available Antifreezes section on page 12.

**WARNING!**
Unit must be installed on a surface that is the same elevation as incoming road. Shims may be utilized if necessary.
Available Antifreezes

**WARNING:** Water in the ACZ-350™ System segments is critical for proper performance. Special care should be taken to prevent the water from freezing, refer to the "Available Antifreezes" section of this manual for additional information.

**WARNING:** Do not use the ACZ-350™ System when the water in the system is frozen or is in danger of freezing without antifreeze. Using the ACZ-350™ System when frozen will prevent proper system behavior during an impact. Failure to follow this warning can result in serious injury or death in case of collision with the ACZ-350™ System.

**Salt** (Sodium Chloride) – 20% solution by weight protects to 0°F. Low cost. Corrosive. Needs to be premixed and large spills may be harmful to vegetation.

**Calcium Chloride** – 35% solution by weight protects to -20°F. Medium cost. Corrosive to zinc. Large spills may be harmful to vegetation and spills may be slick. A significant amount of heat is generated during mixing which may require mixing before placing in the barrier.

**Ethylene Glycol** – 50% solution by volume protects to -20°F. Medium to high cost. Large spills should be considered dangerous due to potential for environmental harm. Spills may also be slick.

**Propylene Glycol** – 50% solution by volume protects to -20°F. High cost. Large spills may be harmful to vegetation and spills may be slick.

**Liquid CMA** (Calcium Magnesium Acetate) – 25% solution by volume protects to 0°F. Very high cost. Considered environmentally safe and nontoxic.

**Liquid Potassium Acetate** – 60% solution by volume protects to -20°F. Extremely high cost. Considered environmentally safe and nontoxic.

**Notes:**

1. The water/antifreeze mixture should be returned to the water truck and recycled for environmental reasons and to save the cost of antifreeze.
2. For those mixtures that may be slick, the solution should be washed away with large amounts of water and the area should be sanded to prevent skidding.
3. Regardless of which antifreeze is chosen, the user should check local ordinances related to environmental issues.
4. To minimize corrosion of galvanized steel frames, keep segments full of chloride solution. If drained, rinse thoroughly and dry the frames.
Installation

Preparation for Installation
Using the drawings supplied with the System, conduct a parts inventory check to make sure all necessary components are available before proceeding to the site. Visually check the sections for damage to ensure that they will hold water. Additional sets of installation drawings may be obtained by telephoning customer service.

Required Tools
For a typical installation the recommended tools and equipment are:
1. ACZ-350™ System Installation and Maintenance Manual
2. Application and/or traffic control plan (as required)
3. Traffic control equipment (as required)
4. ACZ-350™ System components
5. Sledge Hammer
6. Pry Bar
7. Adjustable Wrench
8. Open End Wrenches: 15/16” and 1 1/8”
9. Sockets and Ratchet: 9/16”, 3/4” and 15/16”
10. Steel Cutting Tool
11. Cold Galvanizing Spray
12. Forklift (optional)
13. Transport Truck
14. Water Truck with 950 to 1135 liter/min. [250 to 300 GPM] output pump

Installing the TL-2 ACZ-350TM System

Warning: Work from the non-traffic side of the installation whenever possible.

1. A flat bed truck with a low bed is ideal for transporting the ACZ-350™ System. Secure the load properly before transporting.
   Note: The maximum weight of each Barrier segment (empty) is 156 kg [344 lb].
2. Deploy traffic control. A traffic control plan appropriate to the complexity of the project should be prepared and understood by all parties before the ACZ-350™ System is installed.
3. Unload the components taking care not to damage.
### Parts List: Various Transition Adapters

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Connection Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>617872 B</td>
<td>Universal Transition Assy</td>
<td>N/A</td>
</tr>
<tr>
<td>617890 B</td>
<td>U-Bolts</td>
<td>Pin &amp; Loop</td>
</tr>
<tr>
<td>603496 B</td>
<td>Channel</td>
<td>Pin &amp; Loop</td>
</tr>
<tr>
<td>616019 B</td>
<td>3 Mechanical Anchors</td>
<td>None</td>
</tr>
<tr>
<td>616202 B</td>
<td>Australia RTA</td>
<td>None</td>
</tr>
<tr>
<td>616017 B</td>
<td>Texas J-Hook</td>
<td>J-Hook</td>
</tr>
<tr>
<td>616018 B</td>
<td>Texas X-Bolt</td>
<td>X-Bolt</td>
</tr>
<tr>
<td>616016 B</td>
<td>Quebec</td>
<td>T-Slot</td>
</tr>
<tr>
<td>616203 B</td>
<td>British Columbia</td>
<td>None / Recessed</td>
</tr>
</tbody>
</table>

**UNIVERSAL TRANSITION 617872B**
PIN & LOOP ADAPTER 617890B
SHOWN - OTHERS AVAILABLE
UPON REQUEST – SEE TABLE

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**NOTE:** NO HOLD-DOWN HARDWARE
LAMINATED STRAPS

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Installing the TL-2 Universal Transition

1. Measure the Barrier width at the base, 16" and 24" above the ground (See Figure 6).
2. Adjust the Wheel Deflectors to be the same width as the base of the Barrier (See Figure 7).
3. Adjust the Lower Arms to be 1/8" wider than the Barrier width 16" above the ground (See Figure 8).
4. Adjust the Upper Arms to be 1/8" wider than the Barrier width 24" above the ground (See Figure 8).

**Note:** During adjustment of the Wheel Deflector, Lower and Upper Arms, be careful to position the threaded rod to minimize snagging. Trim threaded rod as necessary; touch up with cold galvanizing compound. Verify all adjusting hardware is secure.

![Figure 6](image1.png)

![Figure 7](image2.png)

![Figure 8](image3.png)
Assembling the TL-2 Transition (Pin and Loop)

1. Slide and pin the Transition around the end of the PCMB or hazard. Verify the two large U-Bolts are positioned to cradle the Transition Connection Pin and Insert.
2. Evenly tighten the four nuts attached to the U-Bolt capturing the Transition Connection Pin.
3. Use the Transition as a template to drill two 7/8" holes through the PCMB.
4. Insert the 3/4” Threaded Rods and fasten using the supplied nuts and washers.
5. Trim Threaded Rod and U-Bolt after installation to segment, ensuring that the Threaded Rod does not extend more than 3 mm [1/8"] past secured nut. Touch up with cold galvanizing.

Note: These Transition Instructions are for the standard Pin and Loop concrete barrier. See separate instructions which are included with other styles of Transition Assemblies.

Parts List: Universal Transition Assembly to Pin and Loop Barrier

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>617872B</td>
<td>1</td>
<td>Universal Transition</td>
</tr>
<tr>
<td>617890B</td>
<td>1</td>
<td>Pin and Loop</td>
</tr>
<tr>
<td>612045G</td>
<td>1</td>
<td>Pin</td>
</tr>
<tr>
<td>118027G</td>
<td>8</td>
<td>3/4&quot;x2&quot; Heavy Flat Washer</td>
</tr>
<tr>
<td>118089G</td>
<td>8</td>
<td>3/4&quot; Lock Washer</td>
</tr>
<tr>
<td>115953G</td>
<td>8</td>
<td>3/4&quot; Hex Nut</td>
</tr>
<tr>
<td>117543G</td>
<td>2</td>
<td>3/4&quot;x8 1/2&quot; Stud</td>
</tr>
<tr>
<td>117870G</td>
<td>2</td>
<td>U-Bolt</td>
</tr>
</tbody>
</table>

Figure 9
Assembling the TL-2 Bay

1. Align the TL-2 Bay Assembly in front of the Transition. Notice the orientation of the rear End Knuckles (See Figure 10).
2. Place the Retainer Nut under the Barrier segment and insert the Long Connecting Pin through the Transition and Barrier segment.
3. Insert the Long Rod Assembly through the Long Connecting Pin (See Detail on Figure 10).
4. Use a ratchet with a 3/4" deep well socket to rotate the long Threaded Rod clockwise to thread the Retaining Nut onto the Threaded Rod. The Retaining Nut on the bay will not pull up tight against the bottom of the Barrier segment at this position.
5. Attach the Bar Washer on top of the Connecting Pin with the 5/8” bolt and lock washer.

Parts List: Assembly of TL-2 Bay Assembly to Transition

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>617871B</td>
<td>1</td>
<td>TL-2 Bay Assembly</td>
</tr>
<tr>
<td>612038Y</td>
<td>1</td>
<td>Long Connecting Pin</td>
</tr>
<tr>
<td>117545G</td>
<td>1</td>
<td>5/8&quot;-11 x 31&quot; Threaded Stud</td>
</tr>
<tr>
<td>003364G</td>
<td>1</td>
<td>5/8&quot;x1 1/2&quot; Hex Bolt</td>
</tr>
<tr>
<td>613730G</td>
<td>1</td>
<td>Retainer Nut</td>
</tr>
<tr>
<td>118100G</td>
<td>1</td>
<td>1/4&quot; Lock Washer</td>
</tr>
<tr>
<td>115986G</td>
<td>1</td>
<td>5/8-11x2 1/8 Hex Coupling Nut</td>
</tr>
<tr>
<td>115970G</td>
<td>1</td>
<td>5/8&quot; Hex Nut</td>
</tr>
<tr>
<td>617018G</td>
<td>1</td>
<td>3/16x2x2 Bar Washer</td>
</tr>
</tbody>
</table>
Assembling the TL-2 Nose

1. Position the Nose in front of the TL-2 Bay Assembly aligning the connection holes.
2. Insert the Short Connecting Pin through the Barrier segment and Nose.
3. Insert the Short Rod Assembly (See Detail on Figure 11) through the Short Connecting Pin.
4. Use a ratchet with a 3/4" deep well socket to fasten the Threaded Rod to the Nose.
5. Attach the Bar Washer on top of the Connecting Pin with the 5/8" bolt and lock washer (See Figure 11).
6. Attach Nose Striping Plate as required for specific site requirements using 1/4" bolt, lock washer and spring nut (See Figure 11).
### Parts List: Assembly of Nose to TL-2 Bay Assembly

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>617871B</td>
<td>1</td>
<td>TL-2 Bay Assembly</td>
</tr>
<tr>
<td>611585B</td>
<td>1</td>
<td>Nose</td>
</tr>
<tr>
<td>612022Y</td>
<td>1</td>
<td>Short Connecting Pin</td>
</tr>
<tr>
<td>117546G</td>
<td>1</td>
<td>5/8&quot;-11 x 9&quot; Threaded Stud</td>
</tr>
<tr>
<td>003364G</td>
<td>1</td>
<td>5/8&quot; x 1 1/2&quot; Hex Bolt</td>
</tr>
<tr>
<td>118100G</td>
<td>1</td>
<td>5/8&quot; Lock Washer</td>
</tr>
<tr>
<td>115970G</td>
<td>1</td>
<td>5/8&quot; Hex Nut</td>
</tr>
<tr>
<td>115986G</td>
<td>1</td>
<td>5/8-11x2 1/8&quot; Hex Coupling Nut</td>
</tr>
<tr>
<td>617018G</td>
<td>1</td>
<td>3/16x2x2&quot; Bar Washer</td>
</tr>
<tr>
<td>113518G</td>
<td>9</td>
<td>1/4&quot; x 3/4&quot; Hex Bolt</td>
</tr>
<tr>
<td>118085G</td>
<td>9</td>
<td>1/4&quot; Lock Washer</td>
</tr>
<tr>
<td>116051G</td>
<td>9</td>
<td>1/4&quot; Spring Nut</td>
</tr>
<tr>
<td>611644B</td>
<td>1</td>
<td>Striping Plate, Left and Right</td>
</tr>
<tr>
<td>611649B</td>
<td>1</td>
<td>Striping Plate Gore and Blank</td>
</tr>
</tbody>
</table>

**NOTE:** Different Striping patterns are available. Contact Customer Service for additional information.

**Warning:** For proper system functioning, only use one Striping Plate provided by Manufacturer.

**Warning:** Each joint must be connected with a Connection Pin and Secured Rod Assembly or improper impact performance will result. The Barrier segment must not be used if Steel Stiffener is damaged or missing.
7. Remove the Water Level Indicator Retaining Decal with a small flat screw driver before filling the Barrier segment with water (See Figures 12 and 13).

8. If the Water Level Indicator is damaged, reach inside the Barrier segment, remove the damaged Indicator and replace with a new one.

SHORT ROD ASSEMBLY DETAIL

Figure 11
Remove the Fill Hole Cap and completely fill both Barrier segments with water. Approximately 1100 liters (290 gallons) will be required.

The water truck can follow immediately behind the deployment crew to minimize time in the work zone. Filling proceeds more quickly if one worker drives the water truck and another moves the fill hose from section to section.

**Warning:** All Barrier segments must be filled with water to ensure proper crash performance.

**Warning:** Water in the ACZ-350™ System segments is critical for proper performance. Special care should be taken to prevent the water from freezing, refer to the "Available Antifreezes" section, page 12, of this manual for additional information.

**Warning:** Do not use the ACZ-350™ System when the water in the system is frozen or is in danger of freezing without antifreeze. Using the ACZ-350™ System when frozen will prevent proper system behavior during an impact. Failure to follow this warning can result in serious injury or death in case of collision with the ACZ-350™ System.

**Warning:** Water on traveled roadways may create a slippery surface for vehicles. Repair or replace all leaking or damaged segments.

1. Replace caps in fill holes to retard water evaporation and to prevent debris, bugs and birds from contaminating the water.
2. Deployment is complete; refer to the "Checking the Installation" section, page 34, for guidance.
Installing the TL-3 ACZ-350™ System

**Warning:** Work from the non-traffic side of the installation whenever possible.

1. A flat bed truck with a low bed is ideal for transporting the ACZ-350™ System. Secure the load properly before transporting.  
   **Note:** The maximum weight of each Barrier segment (empty) is 156 kg [344 lb].
2. Deploy traffic control. A traffic control plan appropriate to the complexity of the project should be prepared and understood by all parties before the ACZ-350™ System is installed.
3. Unload the components taking care not to damage them and place in a safe convenient location.

![Diagram of ACZ-350™ System components]

---

**Parts List: Various Transition Adapters**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Connection Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>617872</td>
<td>Universal Transition Assy</td>
<td>N/A</td>
</tr>
<tr>
<td>617890</td>
<td>U-Bolts</td>
<td>Pin &amp; Loop</td>
</tr>
<tr>
<td>603496</td>
<td>Channel</td>
<td>Pin &amp; Loop</td>
</tr>
<tr>
<td>616019</td>
<td>3 Mechanical Anchors</td>
<td>None</td>
</tr>
<tr>
<td>616202</td>
<td>Australia RTA</td>
<td>None</td>
</tr>
<tr>
<td>616017</td>
<td>Texas J-Hook</td>
<td>J - Hook</td>
</tr>
<tr>
<td>616018</td>
<td>Texas X-Bolt</td>
<td>X - Bolt</td>
</tr>
<tr>
<td>616016</td>
<td>Quebec</td>
<td>T - Slot</td>
</tr>
<tr>
<td>616203</td>
<td>British Columbia</td>
<td>None / Recessed</td>
</tr>
</tbody>
</table>

---

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Installing the TL-3 Universal Transition

1. Measure the Barrier width at the base, 16" and 24" above the ground (See Figure 15).
2. Adjust the wheel deflectors to be the same width as the base of the Barrier (See Figure 16).
3. Adjust the lower arms to be 1/8" wider than the barrier width 16" above the ground (See Figure 17).
4. Adjust the upper arms to be 1/8" wider than the barrier width 24" above the ground (See Figure 17).

NOTE: During adjustment of the wheel deflector, lower and upper arms, be careful to position the threaded rod to minimize snagging. Trim threaded rod as necessary; touch up with cold galvanizing compound. Verify all adjusting hardware is secure.
Assembling the TL-3 Transition (Pin and Loop)

1. Slide and pin the Transition around the end of the PCMB or hazard. Verify the two large U-bolts are positioned to cradle the Transition Connection Pin and insert.
2. Evenly tighten the four nuts attached to the U-bolt capturing the Transition Connection Pin.
3. Use the transition as a template to drill two 7/8” holes through the PCMB.
4. Insert the 3/4” threaded rods and fasten using the supplied nuts and washers.
5. Trim the threaded rod and U-Bolt after installation to segment, ensuring that the rod does not extend more than 3 mm [1/8"] past the secured nut. Touch up with cold galvanizing.

Note: These Transition instructions are for the standard Pin and Loop concrete barrier. See separate instructions which are included with other styles of Transition Assemblies.

Parts List: Universal Transition Assembly with Pin and Loop Barrier

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>617872B</td>
<td>1</td>
<td>Universal Transition</td>
</tr>
<tr>
<td>617890B</td>
<td>1</td>
<td>Pin and Loop Assembly</td>
</tr>
<tr>
<td>612045G</td>
<td>1</td>
<td>Pin</td>
</tr>
<tr>
<td>118027G</td>
<td>8</td>
<td>3/4” x 2” Heavy Flat Washer</td>
</tr>
<tr>
<td>118089G</td>
<td>8</td>
<td>3/4” Lock Washer</td>
</tr>
<tr>
<td>115953G</td>
<td>8</td>
<td>3/4” Hex Nut</td>
</tr>
<tr>
<td>117543G</td>
<td>2</td>
<td>3/4” x 8 1/2” Stud</td>
</tr>
<tr>
<td>117870G</td>
<td>2</td>
<td>U-Bolt</td>
</tr>
</tbody>
</table>
Assembling the TL-3 Rear Bay

1. Align the TL-3 Rear Bay Assembly in front of the Transition. Notice the orientation of the Rear Bay End Knuckles (See Figure 19).
2. Place the Retainer Nut under the Barrier segment and insert the Long Connecting Pin through the transition and Barrier segment.
3. Insert the Long Rod Assembly through the Long Connecting Pin (See Detail in Figure 19).
4. Use a ratchet with a 3/4” deep well socket to rotate the long Threaded Rod clockwise to thread the Retaining Rut onto the Threaded Rod. The Retaining Nut on the rear bay will not pull up tight against the bottom of the Barrier segment at this position.
5. Attach the Bar Washer on top of the Connecting Pin with the 5/8” bolt and lock washer.

Figure 18
### Parts List: Assembly of Rear Bay Assembly to Transition

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>613624B</td>
<td>1</td>
<td>Rear Bay Assembly</td>
</tr>
<tr>
<td>612038Y</td>
<td>1</td>
<td>Long Connecting Pin</td>
</tr>
<tr>
<td>117545G</td>
<td>1</td>
<td>5/8&quot;-11 x 31&quot; Threaded Stud</td>
</tr>
<tr>
<td>003364G</td>
<td>1</td>
<td>5/8&quot; x 1 1/2&quot; Hex Bolt</td>
</tr>
<tr>
<td>613730G</td>
<td>1</td>
<td>Retainer Nut</td>
</tr>
<tr>
<td>118100G</td>
<td>1</td>
<td>5/8&quot; Lock Washer</td>
</tr>
<tr>
<td>617018G</td>
<td>1</td>
<td>3/16x2x2&quot; Bar Washer</td>
</tr>
<tr>
<td>115970G</td>
<td>1</td>
<td>5/8&quot; Hex Nut</td>
</tr>
<tr>
<td>115986G</td>
<td>1</td>
<td>5/8-11x2 1/8&quot; Hex Coupling Nut</td>
</tr>
</tbody>
</table>

**Figure 19**

*Detail - Rear End Knuckle*
Warning: System will not perform properly if the retaining nut is not firmly attached to the pin assembly

Assembling the TL-3 Front Bay

1. Position the Front Bay Assembly in front of the Rear Bay Assembly.
2. Loosen the four nuts located on top of the steel stiffeners on the two sections that are to be connected to aid in the process. Notice the orientation of the End Knuckles (See Figure 20).
3. Place the Retainer Nut under the Barrier segment.
4. Reposition the Front Bay Assembly if necessary; insert the Long Connecting Pin through the two Barrier segments.
5. Insert the Long Rod Assembly through the Long Connecting Pin (See Detail in Figure 20).
6. Use a ratchet with a 3/4" deep well socket to rotate the long Threaded Rod clockwise to thread the retaining nut on to the Threaded Rod. The Retaining Nut on the Rear Bay will pull up tight against the bottom of the Barrier segment at this position.
7. Attach the Bar Washer on top of the Connecting Pin with the 5/8" bolt and lock washer.
8. Retighten the nuts on the steel stiffeners.

Parts List: Assembly of Front Bay Assembly to Rear Bay Assembly

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>609117B</td>
<td>1</td>
<td>Front Bay Assembly</td>
</tr>
<tr>
<td>613624B</td>
<td>1</td>
<td>Rear Bay Assembly</td>
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<tr>
<td>612038Y</td>
<td>1</td>
<td>Long Connecting Pin</td>
</tr>
<tr>
<td>117545G</td>
<td>1</td>
<td>5/8&quot;-11 X 31&quot; Threaded Stud</td>
</tr>
<tr>
<td>003364G</td>
<td>1</td>
<td>5/8&quot; x 1 1/2&quot; Hex Bolt</td>
</tr>
<tr>
<td>613730G</td>
<td>1</td>
<td>Retainer Nut</td>
</tr>
<tr>
<td>118100G</td>
<td>1</td>
<td>5/8&quot; Lock Washer</td>
</tr>
<tr>
<td>617018G</td>
<td>1</td>
<td>3/16&quot;x2&quot;x2&quot; Bar Washer</td>
</tr>
<tr>
<td>115970G</td>
<td>1</td>
<td>5/8&quot; Hex Nut</td>
</tr>
<tr>
<td>115986G</td>
<td>1</td>
<td>5/8&quot;-11x2 1/8&quot; Hex Coupling</td>
</tr>
</tbody>
</table>
Warning: System will not perform properly if the retaining nut is not firmly attached to the pin assembly.
Assembling the TL-3 Nose

1. Position the Nose in front of the TL-3 Bay Assembly aligning the connection holes.
2. Insert the Short Connecting Pin through the Barrier segment and nose.
3. Insert the Short Rod Assembly through the Short Connecting Pin (See Detail in Figure 21).
4. Use a ratchet with a 3/4" deep well socket to fasten the Threaded Rod to the Nose.
5. Attach the Bar Washer on top of the Connecting Pin with the 5/8" Bolt and Lock Washer (See Figure 21).
6. Attach Nose Striping Plate as required for specific site requirements using 1/4" Bolt, Lock Washer and Spring Nut (See Figure 21).

Parts List: Assembly of Nose to Front Bay Assembly

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Quantity</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>609117B</td>
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<tr>
<td>611585B</td>
<td>1</td>
<td>Nose</td>
</tr>
<tr>
<td>612022Y</td>
<td>1</td>
<td>Short Connecting Pin</td>
</tr>
<tr>
<td>117546G</td>
<td>1</td>
<td>5/8&quot;-11 x 9&quot; Threaded Stud</td>
</tr>
<tr>
<td>003364G</td>
<td>1</td>
<td>5/8&quot; x 1 1/2&quot; Hex Bolt</td>
</tr>
<tr>
<td>118100G</td>
<td>1</td>
<td>5/8&quot; Lock Washer</td>
</tr>
<tr>
<td>115970G</td>
<td>1</td>
<td>5/8&quot; Hex Nut</td>
</tr>
<tr>
<td>115986G</td>
<td>1</td>
<td>5/8-11x2 1/8&quot; Hex Coupling Nut</td>
</tr>
<tr>
<td>617018G</td>
<td>1</td>
<td>3/16x2x2&quot; Bar Washer</td>
</tr>
<tr>
<td>113518G</td>
<td>9</td>
<td>1/4&quot; x 3/4&quot; Hex Bolt</td>
</tr>
<tr>
<td>118085G</td>
<td>9</td>
<td>1/4&quot; Lock Washer</td>
</tr>
<tr>
<td>116051G</td>
<td>9</td>
<td>1/4&quot; Spring Nut</td>
</tr>
<tr>
<td>611644B</td>
<td>1</td>
<td>Striping Plate, Left and Right</td>
</tr>
<tr>
<td>611649B</td>
<td>1</td>
<td>Striping Plate Gore and Blank</td>
</tr>
</tbody>
</table>

Note: Different Striping patterns are available. Contact Customer Service for additional information.

Warning: For proper system functioning only use one Striping Plate provided by the Manufacturer.

Warning: Each joint must be connected with a Connection Pin and Secured Rod Assembly or improper impact performance will result. Barrier segment must not be used if Steel Stiffener is damaged or missing.
7. Remove the Water Level Indicator Retaining Decal with a small flat screw driver before filling the Barrier segment with water. See Figures 22 and 23.
8. If the water level indicator is damaged, reach inside the barrier, remove the damaged indicator and replace with a new one.

Figure 21
9. Remove the Fill Hole Caps and completely fill all four Barrier segments with water. Approximately 2200 liters (580 gallons) will be required.
10. The water truck can follow immediately behind the deployment crew to minimize time in the work zone. Filling proceeds more quickly if one worker drives the water truck and another moves the fill hose from section to section.

**Warning:** All Barrier segments must be filled with water to ensure proper crash performance.

**Warning:** Water in the ACZ-350™ System Segments is critical for proper performance. Special care should be taken to prevent the water from freezing, refer to the "Available Antifreezes" section of this manual for additional information.

**Warning:** Do not use the ACZ-350™ System when the water in the system is frozen or is in danger of freezing without antifreeze. Using the ACZ-350™ System when frozen will prevent proper system behavior during an impact. Failure to follow this warning can result in serious injury or death in case of collision with the ACZ-350™ System.

**Warning:** Water on traveled roadways may create a slippery surface for vehicles. Repair or replace all leaking or damaged segments.

11. Replace caps in fill holes to retard water evaporation and to prevent debris, bugs and birds from contaminating the water.
12. Deployment is complete. Take the time to double check the installation.
Converting the TL-3 ACZ-350TM System to TL-2

Note: Only TL-3 ACZ-350™ Systems with the updated steel nose can be converted to a TL-2 System. Figure 24 shows the difference between the old and the new steel nose.

1. To change a TL-3 ACZ-350™ System to a TL-2 ACZ-350™ System, only the front two barriers, spacer, and the center hardware that holds down the lead Barrier segment top stiffener for the new front barrier are removed.

2. The nose is then attached to the remaining two barriers. See Figure 25.
Converting the TL-2 ACZ-350TM System to TL-3

1. The following parts must be ordered and/or added to convert from TL-2 to TL-3:

Parts List: TL-2 to TL-3 ACZ-350™ System Conversion

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>609117B</td>
<td>1</td>
<td>Front Bay Assembly, ACZ-350™, TL-3</td>
</tr>
<tr>
<td>612017B</td>
<td>1</td>
<td>Pin Assembly, ACZ-350™, Long</td>
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<tr>
<td>118092G</td>
<td>4</td>
<td>3/8” Lock Washer, G</td>
</tr>
<tr>
<td>115960G</td>
<td>4</td>
<td>3/8” Hex Nut, G</td>
</tr>
<tr>
<td>617007G</td>
<td>2</td>
<td>Bar Washer, 10 Gauge, G</td>
</tr>
<tr>
<td>608521G</td>
<td>2</td>
<td>Flat Steel 1/4x4x6”, with Notches, G</td>
</tr>
<tr>
<td>117871G</td>
<td>2</td>
<td>U-Bolt, Square, 3/8-16x2 3/8x2 3/8”, G</td>
</tr>
</tbody>
</table>

2. Attach the hardware on the front segment of the rear bay as shown in Figure 26.
3. Insert the front bay assembly between the steel nose and the modified TL-2 Assembly as shown in Figure 26.

Figure 26

**Warning:** System will not perform properly if the retaining nut is not firmly attached to the pin assembly.
Checking the Installation
1. Check the installation to ensure that all sections are properly aligned, full of water ballast, and not leaking.
2. All fill level indicators should be up. If any are not up, check to see if the Retaining Decals for shipment are still in place, and, if they are, remove them.
3. Make sure that all steel stiffeners and side straps are present and all pins are securely inserted.
4. If for any reason a section needs replacement, refer to the "Maintenance and Repair" section of this manual, page 36.

Retrieval
1. Begin retrieval at the nose end of the System by removing the water ballast. If site conditions permit, the quick release gate valve may be opened to allow the water to drain. **Note:** It takes approximately 4.5 minutes to drain a Barrier segment.

   **Caution:** Water on traveled roadways may create a slippery surface for vehicles. Proper traffic control should be deployed.

2. If the water cannot be drained at the site, the water may either be siphoned out or each water-filled segment can be unpinned, disassembled, and moved by forklift to another work area or a site where it may be drained or stored.

   **Caution:** Do not lift more than one filled Barrier segment at a time.

   **Caution:** Do not use steel stiffener to lift Barrier segment. Use fork lift and lift ports.

3. Remove the pins and separate the segments.
4. Load the segments onto the transport truck in the reverse order they were deployed. Secure the load before transporting.

Storing Empty ACZ-350TM Segments
To maintain ACZ-350TM System’s portability, it is best not to let water enter the system and freeze.

Possible solutions are to:
- cover the sections with waterproof tarp,
- leave the gate valves partially open to allow drainage or
- store the sections upside down, being careful not to damage the water level floats.

**Note:** Empty segments may be stacked up to three high. Filled segments must not be stacked.
**Maintenance and Repair**

Proper maintenance of the ACZ-350™ System is essential to assure maximum performance. Take time to review the product limitations, installation cautions, and maintenance instructions before performing the necessary work. Do not attempt to install any crash cushion without the proper plans for the installation.

The time interval between maintenance inspections depends a great deal upon particular site conditions. Frequent inspections are recommended until a longer inspection interval becomes justified.

**Post Impact Inspection**

1. Inspect each system segment for defects. 
   Replace any barrier that is deformed or unable to hold water. Do not attempt to straighten or reshape. Attempts to do so may further damage the Barrier segment or change the energy absorbing characteristics.

   Replacing the damaged Barrier segment is critical to the performance of the system. Failure to follow this warning could result in serious injury or death in the event of a collision.

2. Inspect all steel straps, pins and stiffeners.
   Replace any steel component that is deformed. Do not attempt to weld, straighten, or reshape. Attempts to do so may further damage the steel components or change the energy absorbing characteristics.

   Replacing damaged steel components is critical to the performance of the system. Failure to follow this warning could result in serious injury or death in the event of a collision.

3. Inspect the Nose for damage.
   Replace the Nose if deformed. Do not attempt to straighten or reshape. Attempts to do so may further damage the Nose or change the energy absorbing characteristics.

   Replacing the damaged Nose is critical to the performance of the system. Failure to follow this warning could result in serious injury or death in the event of a collision.

4. Inspect the transition for damage.
   Although unlikely, the transition could be damaged during impact. Replace the transition if deformed. Do not attempt to straighten or reshape. Attempts to do so may further damage the transition or change the performance characteristics.
Replacing the damaged Transition is critical to the performance of the system. Failure to follow this warning could result in serious injury or death in the event of a collision.

5. **Inspect the attaching concrete or steel barrier.**
Replace the attaching barrier if deformed or cracked. Do not attempt to straighten, reshape or patch. Attempts to do so may further damage the barrier or change the energy absorbing characteristics.

Replacing damaged concrete or steel barrier is critical to the performance of the system. Failure to follow this warning could result in serious injury or death in the event of a collision.

**Items that might need replacement after an impact:**

- Nose Assembly (Striping patterns available upon request) 611655B
- Front Bay Assembly (TL-3 only) 609117B
- Rear Bay Assembly (TL-3 only) 613624B
- Bay Assembly (TL-2 only) 617871B
- Strap Assembly 614703B
- Top Stiffener 614703B
- Plastic Barrier with Frame 614703B
- Plastic Barrier without Frame 604943B
- Long Connecting Pin Assembly 612017B
- Short Connecting Pin Assembly 612015B

**Warning:** Use only the system specific Energy Absorption Systems’ parts for installing, maintaining, or repairing the ACZ-350™ System. Installation, maintenance, or repairs using unauthorized accessories is strictly prohibited. Failure to follow this warning will compromise the acceptance of this system by the FHWA and could result in serious injury or death in the event of a vehicle impact with a NONAPPROVED system. **Using parts from another Energy Absorption Systems or Trinity Highway Products system is never acceptable. Each system has its own unique parts for use.**

**Visual Drive-by Inspection**

A slow drive-by visual inspection of the ACZ-350™ System is often all that is required. Some specific inspection considerations are:

1. Are all segments full of water ballast?
   - The segments must be adequately filled for proper impact performance. Look to see that the fill level indicators are visible above the top of each segment. A walk-up inspection of the installation is required if the fill indicators are not visible (see Walk-Up Inspection section, page 38). Be sure the fill indicator Retaining Decals used for shipping have been removed.
2. Are the segments properly aligned?
   The installation must be aligned according to the plans for the site. Misaligned segments in the middle of an installation may be an indication that the system has been hit and potentially damaged. If any segments are misaligned, conduct a walk-up inspection.

3. Is there fluid on the ground?
   The segments must be adequately filled for proper impact performance. Leaking segments in the middle of an installation may be an indication that the system has been hit and potentially damaged. A walk-up inspection of the installation is required if fluid is present in the surrounding area.

Walk-up Inspection

If the drive-by visual inspection indicates maintenance is required, then a walk-up inspection is necessary. Some of the most common maintenance concerns and corresponding repair techniques are:

Misaligned Segments

Segments may occasionally become misaligned due to impact or nuisance hits. Generally 600 to 900 mm [2' to 3'] of lateral misalignment is easily corrected by simply pushing the segments back into alignment. If the segments are emptied, they can usually be pushed manually; if they are full, they can be nudged into position with a vehicle, forklift, or pry bar. Be sure to use the forklift ports when appropriate. Care must be taken to avoid damaging the segments.

Damaged Segments

Generally segments are usable if they remain full of water and properly connected to other segments. Occasionally, segments may become damaged from impact or puncture and must be replaced. Segments with minor damage or leaks may often be repaired using sealants or plastic welding methods (See “Segment Patching Preparation”, page 39).

1. Empty the water from the segments immediately surrounding the damaged segment(s).
2. Remove the pins and other attaching hardware of the damaged segment(s) and slide the segment(s) sideways until enough gap opens up in the installation for removal.
3. New segments are replaced by reversing this process.
4. Take care to work on the side away from traffic and to properly line up the installation when replacement is complete (see “Misaligned Segments”).

Pin Removal

1. Remove 5/8” bolt, washer, and rod hardware.
2. Pry pin up while pushing steel stiffener down.
3. Once the pin is up approximately 100 to 125 mm [4" to 5"], it can be twisted to remove.

Leaking Segments

Segments with water levels below 100 mm [4"] from the top must be refilled for proper ACZ-350™ System performance.

Segments with very low water levels, or those that consistently need filling should be filled and thoroughly inspected for leaks. If leaks are found, the segment should be replaced or repaired (See “Damaged Segments”).

A certain amount of water loss may occur due to evaporation depending on the environment.
Segment Patching Preparation
The area to be patched must be completely dry and free of dirt and grease. Additionally, a film coats the segments and should be removed by either lightly sanding the pieces or burning it off with a small butane torch. Do not damage the plastic by overheating. A few quick passes are sufficient.

Plastic Welding
The most reliable means of patching can be accomplished with plastic welding and can range from "stick" welding to automatic preparation and feed. The temperature, as measured 6 mm [1/4"] away from the welding torch should be at 290°C [550°F] for the ACZ-350™ material. Welding speed for ideal, straight line welds can range from 100 mm to 150 mm [4" to 6"] per minute with stick welding to 600 mm [24"] per minute with an automatic gun. A plastic welding equipment supplier can offer additional information.

Spin Weld Plugs
Spin Weld plugs give excellent results for patching small holes and leaks in segments. Individuals who will be performing the repairs should read the instructions and practice a few times before trying to repair ACZ-350™ System segments. Practicing the Spin Weld process is important as this gives the individual a feel for the techniques required to perform a proper weld.

Items necessary for a repair:
- Drill Motor with 7 mm Drill Bit
- 25,000 rpm Router
- Spin Weld Tool
- Spin Weld Plugs
- Rasp

Procedure
1. Drill a 7 mm hole at point of leak.
2. Secure the Spin Weld tool into Router.
3. Place a Spin Weld plug onto the Spin Weld tool.
4. Place plug and router squarely over the hole to be plugged.
5. Turn on the router, holding it firmly with light downward pressure. Watch for indications of melting plastic flowing around the plug. Turn off the router but hold it steady until the plastic solidifies.
6. Inspect the plug to insure that it has bonded to the system segment.
7. Rasp the plugged area smooth to finish repair.

Hot Glue Gun
Relatively good success in patching the ACZ-350™ System Barrier segments can be accomplished with a standard hot glue gun using general purpose adhesive. This type of patching will deteriorate over an extended period of exposure to the sun and other environmental conditions. The best results will be obtained by using patience and large amounts of glue.
Field Patching

Initial preparation as outlined above should be accomplished whenever feasible. No materials are available that adhere properly when applied to a wet segment. Duct tape (silver, fiber reinforced tape) sticks to the segment well, and Butyl caulking (gray, sticky pads or rolls) works fairly well to fill gaps for temporary patching.

The blue and yellow ACZ-350™ System decals stick well to the Barrier segments. Spare decals can be kept on hand and cut to size with scissors for effective temporary patch. The decal will need to be placed smoothly without air pockets or creases to obtain the best results. Smaller holes on smooth faces will seal while larger gashes can be reduced to minor trickles. Should the decal begin to leak, it will deteriorate rapidly.

Either fiberglass resin or epoxy can be used to fill and plug leaks. Epoxy's liquid consistency makes it more difficult to keep in any hole during its cure, but is effective if this shortfall can be overcome. Fiberglass resin and sheeting or cloth can be used on larger areas. The exterior of the matte must be completely covered with resin. Otherwise, any exposed fibers will quickly act like wicks and the patch will fail. The resin or epoxy will require a curing time before the segment may be refilled with water.

Any repaired Barrier segments should be marked for easy identification. It is recommended to periodically check the repairs for leaks.

Gate Valves and Plugs

Gate valves must be unbolted before adapters can be unscrewed. Six or seven wraps of Teflon tape will keep the threads from leaking.

![Figure 27](image1.png)  ![Figure 28](image2.png)
## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
<th>(Reference Source)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrier</td>
<td>A device that provides a physical limitation through which a vehicle would not normally pass. It is intended to contain or redirect an errant vehicle.</td>
<td>(A)</td>
</tr>
<tr>
<td>Bidirectional</td>
<td>A traffic direction in relation to the hazard which is one direction on one side of the hazard and the opposite direction on the other side.</td>
<td>(E)</td>
</tr>
<tr>
<td>Capacity</td>
<td>The ability of an appurtenance to absorb the kinetic energy of an impacting vehicle in a safe and controlled manner.</td>
<td>(E)</td>
</tr>
<tr>
<td>Clearance</td>
<td>Lateral distance from edge of traveled way to a roadside object or feature.</td>
<td>(A)</td>
</tr>
<tr>
<td>Clear Zone</td>
<td>The total roadside border area, starting at the edge of the traveled way, available for safe use by errant vehicles. This area may consist of a shoulder, a recoverable slope, a non-recoverable slope, and/or a clear run-out area. The desired width is dependent upon the traffic volumes and speeds, and on the roadside geometry.</td>
<td>(A/N)</td>
</tr>
<tr>
<td>Construction Zone</td>
<td>A highway area under construction or refurbishment with traffic concerns.</td>
<td>(E)</td>
</tr>
<tr>
<td>Crash Tests</td>
<td>Vehicular impact tests by which the structural and safety performance of roadside barriers and other appurtenances may be determined. Three evaluation criteria are considered, namely: (1) structural adequacy, (2) occupant risk, and (3) vehicle trajectory.</td>
<td>(A)</td>
</tr>
<tr>
<td>FHWA Accepted</td>
<td>A system has been crash tested under specified FHWA approved, prevailing criteria and the FHWA has reviewed those results and approved the system for use on the highway system.</td>
<td>(E)</td>
</tr>
<tr>
<td>Critical Impact Point (CIP)</td>
<td>That point along a device with the greatest potential for snagging or pocketing an impacting vehicle.</td>
<td>(E)</td>
</tr>
<tr>
<td>Design Speed</td>
<td>The speed selected and used for correlation of the physical features of a highway that influence vehicle operation. It is the maximum safe speed that can be maintained over a specified section of highway when conditions are so favorable that the design features of the highway govern.</td>
<td>(A)</td>
</tr>
<tr>
<td>End Treatment</td>
<td>The designed modification of a roadside or median barrier at the end.</td>
<td>(A)</td>
</tr>
<tr>
<td>Flare</td>
<td>The variable offset distance of a barrier to move it further from the traveled way.</td>
<td>(A)</td>
</tr>
<tr>
<td>Gating Device (Feature)</td>
<td>A device designed to allow controlled penetration of a vehicle when impacted upstream of the beginning of the length of need (LON). Note that some distance is present between the end of a gating device and the beginning of the LON of the device.</td>
<td>(N)</td>
</tr>
<tr>
<td>Glare Screen</td>
<td>A device used to shield a driver's eye from the headlights of an oncoming vehicle.</td>
<td>(A)</td>
</tr>
<tr>
<td>Hazard</td>
<td>Something dangerous and obstructive in the median, roadway, or roadside.</td>
<td>(E)</td>
</tr>
<tr>
<td>Impact Angle</td>
<td>For a longitudinal barrier, it is the angle between a tangent to the face of the barrier and a tangent to the vehicle's path at impact.</td>
<td>(A)</td>
</tr>
<tr>
<td>Lateral Deflection</td>
<td>The distance an appurtenance is deflected sideways from its original position.</td>
<td>(E)</td>
</tr>
<tr>
<td>Length of Need (LON)</td>
<td>Total length of a longitudinal barrier needed to shield an area of concern.</td>
<td>(A)</td>
</tr>
<tr>
<td>Longitudinal Barrier</td>
<td>A barrier whose primary function is to prevent penetration and to safely redirect an errant vehicle away from a roadside or median hazard.</td>
<td>(A)</td>
</tr>
<tr>
<td>Median</td>
<td>The portion of a divided highway separating the traveled ways for traffic in opposite directions.</td>
<td>(A)</td>
</tr>
<tr>
<td><strong>Median Barrier</strong></td>
<td>A longitudinal barrier used to prevent an errant vehicle from crossing the highway median. (A)</td>
<td></td>
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<td>-------------------</td>
<td>-----------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Non-Gating Device</strong></td>
<td>A device with redirection capabilities along its entire length. Note that the end of a non-gating device is the beginning of the length of need for the device. (N)</td>
<td></td>
</tr>
<tr>
<td><strong>Offset</strong></td>
<td>The distance between the traveled way and a roadside barrier or other obstacle. (A)</td>
<td></td>
</tr>
<tr>
<td><strong>Penetration</strong></td>
<td>Action of a vehicle passing into or through an appurtenance by overcoming its redirective resistance. (E)</td>
<td></td>
</tr>
<tr>
<td><strong>Performance Level</strong></td>
<td>The degree to which a longitudinal barrier is designed for containment and redirection of different types of vehicles and speeds. (A)</td>
<td></td>
</tr>
<tr>
<td><strong>Redirective</strong></td>
<td>A characteristic of an appurtenance that indicates that the device smoothly controls a vehicle angle impact without pocketing or penetration. (E)</td>
<td></td>
</tr>
<tr>
<td><strong>Roadside</strong></td>
<td>That area between the outside shoulder edge and the right-of-way limits. (A)</td>
<td></td>
</tr>
<tr>
<td><strong>Roadside Barrier</strong></td>
<td>A longitudinal barrier used to shield roadside obstacles or non-traversable terrain features. It may occasionally be used to protect pedestrians or &quot;bystanders&quot; from vehicle traffic. (A)</td>
<td></td>
</tr>
<tr>
<td><strong>Roadway</strong></td>
<td>The portion of a highway, including shoulders, for vehicular use. (A)</td>
<td></td>
</tr>
<tr>
<td><strong>Secondary Impact</strong></td>
<td>Vehicle impact(s) subsequent to vehicle loss of contact with an appurtenance. (E)</td>
<td></td>
</tr>
<tr>
<td><strong>Shielding</strong></td>
<td>The introduction of a barrier or crash cushion, between the vehicle and an obstacle or area of concern to reduce the severity of impacts of errant vehicles. (A)</td>
<td></td>
</tr>
<tr>
<td><strong>Slope</strong></td>
<td>The relative steepness of the terrain expressed as a ratio or percentage. Slopes may be positive (back slopes) or negative (fore slopes), and as parallel or cross slopes in relation to the direction of traffic. (A)</td>
<td></td>
</tr>
<tr>
<td><strong>Temporary Barrier</strong></td>
<td>A device used to prevent vehicular access into construction or maintenance work zones and to redirect an impacting vehicle so as to minimize damage to the vehicle and injury to the occupants, while providing worker protection. (A)</td>
<td></td>
</tr>
<tr>
<td><strong>Terminal</strong></td>
<td>A device designed to treat the end of a longitudinal barrier. A terminal may function by (a) decelerating a vehicle to a safe stop within a relatively short distance, (b) permitting controlled penetration of a vehicle behind the device, (c) containing and redirecting the vehicle, or (d) a combination of a, b and c. (N)</td>
<td></td>
</tr>
<tr>
<td><strong>Test Level</strong></td>
<td>A set of impact conditions, defined in terms of vehicular type, mass, speed, and angle, which quantifies the performance level of a traffic barrier. (N)</td>
<td></td>
</tr>
<tr>
<td><strong>Traffic Barrier</strong></td>
<td>A device used to prevent a vehicle from striking a more severe obstacle or feature located on the roadside or in the median, to prevent crossover median accidents, or to provide worker protection. (A)</td>
<td></td>
</tr>
<tr>
<td><strong>Transition</strong></td>
<td>That part of a longitudinal barrier between and connecting sections of differing lateral stiffness. (N)</td>
<td></td>
</tr>
<tr>
<td><strong>Traveled Way</strong></td>
<td>That portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes. (A)</td>
<td></td>
</tr>
<tr>
<td><strong>Underriding</strong></td>
<td>Abrupt movement of an impacting vehicle down and underneath an appurtenance. (E)</td>
<td></td>
</tr>
<tr>
<td><strong>Vaulting</strong></td>
<td>Abrupt movement of an impacting vehicle up and over an appurtenance. (E)</td>
<td></td>
</tr>
<tr>
<td><strong>Vehicle</strong></td>
<td>As used herein an automobile used in transporting passengers ranging in weight and styles from 820 to 2000 kg [1800 to 4415 lb]. (E)</td>
<td></td>
</tr>
<tr>
<td><strong>Warrants</strong></td>
<td>The criteria by which the need for a safety treatment or improvement can be determined. (A)</td>
<td></td>
</tr>
</tbody>
</table>

**Reference Sources:**

www.energyabsorption.com
www.highwayguardrail.com

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