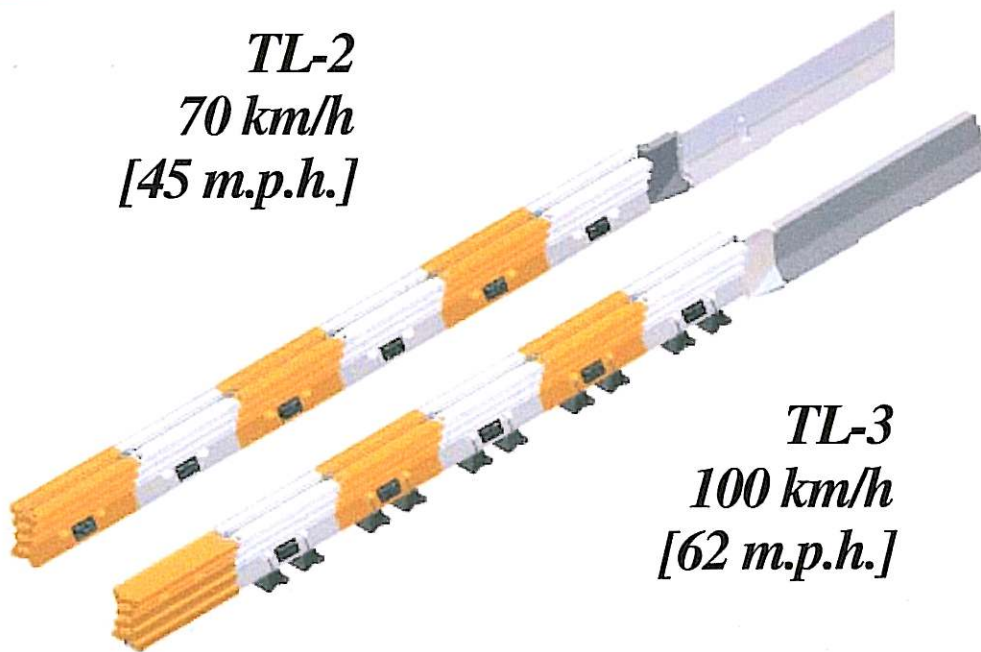


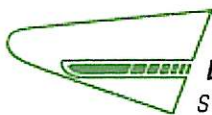
TRITON CONCRETE END TREATMENT™

TL-2
70 km/h
[45 m.p.h.]



TL-3
100 km/h
[62 m.p.h.]

*Highly portable, easy to install,
crashworthy end treatment.*



**ENERGY ABSORPTION
SYSTEMS, INC.**

A Quixote Company
Saving Lives By Design

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Installation/Maintenance

TRITON CONCRETE

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Important Introductory Notes

Proper deployment, installation design, and maintenance of the TRITON Concrete End Treatment System is essential to assure maximum performance. 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 installation manual from the manufacturer.

If you need additional information, or have questions about the TRITON BARRIER, please call Energy Absorption Systems' Customer Service Department. See the back cover for the phone numbers.

System Overview

The TRITON Concrete End Treatment System is highly portable and crashworthy, especially suited for use as a temporary barrier in highway construction zones.

TRITON BARRIER provides several unique advantages over traditional traffic barricades and barriers:

- * Energy-absorbing
- * Quick and easy deployment and retrieval
- * Lightweight
- * Economical
- * Acts as its own crashworthy end treatment
- * Delineation and channelization

TRITON BARRIER is crashworthy and has been thoroughly tested to the National Cooperative Highway Research Program Report 350 (NCHRP 350) testing procedures.

Function

The TRITON Concrete End Treatment System functions as a portable crash cushion to prevent errant vehicles from striking rigid exposed portable concrete wall ends.

Impacting vehicles are brought to a safe and controlled stop when the System is struck on the nose. The TRITON Concrete End Treatment System absorbs impact energy and cushions vehicular impacts while significantly reducing the risk to occupants of the impacting vehicle.

CAUTION: Proper impact performance will only be achieved if all Triton Barrier sections have internal steel frames. The barrier sections with steel frames are orange or natural (off-white) in color. These barrier sections are not to be mixed with similar shaped barrier sections of other colors that do not contain frames (yellow, black or gray).

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Construction

TRITON BARRIER sections are available in white and work zone safety orange colors. Each section is 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. The plastic shell is strengthened by an internal steel framework to provide additional rigidity during handling and impacts. A steel cable, provided along a recess in the top of the section, resists the tensile forces generated during high severity impacts.

The ends of each 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 tension cables for maximum impact performance.

TRITON segments are constructed in a unique shape. The inwardly sloping ribbed side walls interact with an impacting vehicle in a way that resists penetration, vaulting, and underriding. Sections are also stackable to reduce shipping and storage space.

Each TRITON segment is constructed with fork lift ports to allow for mechanical lifting if desired. Large fill openings and a rapid release gate valve are provided to allow quick filling or draining of the water ballast. A permanent fill level indicator in the top of each section allows quick verification that the section is adequately full.

The TRITON Concrete End Treatment System (for 100 km/h [62 m.p.h.] design speed) includes pedestals. The pedestals are made from lightweight polyethylene and is strapped to the forklift ports. The TRITON Concrete End Treatment System (for 100 km/h [62 m.p.h.]) also uses a short pedestal that is made from steel and bolted to the first section, see figure 2.

Triton CET Comparison

TL-2	TL-3
6 sections in length	6 sections in length
No pedestals	Pedestals under all sections
First section empty	First section empty
First section right-side-up	First section up-side-down
First section has no pedestal	First section has short pedestal

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Conformance

The TRITON Concrete End Treatment System has been tested to and conforms with the current guidelines used by the Federal Highway Administration (FHWA) as recommended in:

H. E. Ross, D. L. Sicking, H. S. Perera, and J. D. Michie, "Recommended Procedures for the Safety Performance Evaluation of Highway Features", National Cooperative Highway Research Program Report 350, Transportation Research Board, Washington, D.C., 1993

Selection, and placement of the TRITON Concrete End Treatment System, and design of installation, should conform to applicable guidelines in:

FHWA, "Manual on Uniform Traffic Control Devices for Streets and Highways" Washington, D.C. 1988.

American Association of State Highway and Transportation Officials. "Roadside Design Guide" Washington, D.C.: AASHTO, 1996.

Federal, state, and local criteria governing the TRITON Concrete End Treatment System conformance may vary. Consult local FHWA and State Department of Transportation representatives.

FEATURES:

CONNECTABLE & INTERLOCKING
STACKABLE
LARGE FILL OPENINGS
SAFETY ACCESSORIES AVAILABLE

CAPACITY:

550L [145 GAL.]

WEIGHT:

610KG [1350 LBS] FULL

65 KG [140 LBS] EMPTY

COLORS:

NATURAL [WHITE]

WORK ZONE SAFETY ORANGE

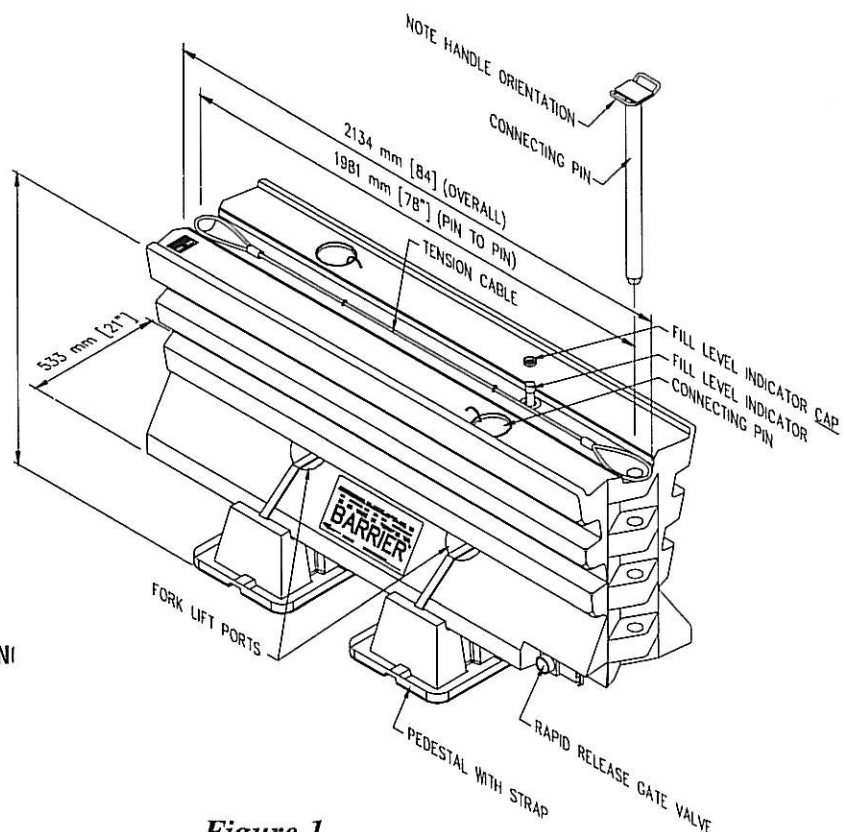


Figure 1

TRITON BARRIER TL-3 Components

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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 TRITON Concrete End Treatment System is deployed in a work zone. Some special site considerations are:

1. What is the design speed at the site? The TRITON Concrete End Treatment System is capable of handling impacts from vehicles up to 2000 kg [4400 lb.] at speeds up to 100 km/h [62 m.p.h.] at angles up to 25 degrees.
2. What foundation will the barrier be deployed on and what is its slope? The TRITON Concrete End Treatment System may be deployed on various surfaces. The existence of cross slopes greater than 5% or curbs may create a vaulting effect on the impacting vehicle.
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 forklift to move full sections to a location where they can be drained.
4. Will the barrier be used in a climate where the water ballast may freeze? The TRITON Concrete End Treatment System will only perform properly if the water ballast is NOT 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.

TRITON CONCRETE

Installation

Preparation for Installation

Using the drawings supplied with the System, conduct a parts inventory check to make sure all the 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 calling customer service using the appropriate phone numbers located on the back page of this manual.

Required Tools

For a typical installation the recommended tools and equipment are:

1. TRITON Concrete End Treatment System Installation & Maintenance manual
2. Application and/or traffic control plan (as required)
3. Traffic control equipment (as required)
4. TRITON Concrete End Treatment System components
5. Transport truck
6. Water truck w/pump*
7. Sledge hammer
8. Pry bar
9. Forklift (optional)

* A pump with 950-1135 liter/min. [250-300 GPM] output and a 75 mm [3"] dia. minimum x 15-30 m [50-100'] long hose with a shut-off control has been shown to be efficient. Time to fill one barrier is approximately 30 seconds.

1. A flat bed truck with a low bed is ideal for transporting the TRITON Concrete End Treatment System. Secure the load properly before transport.

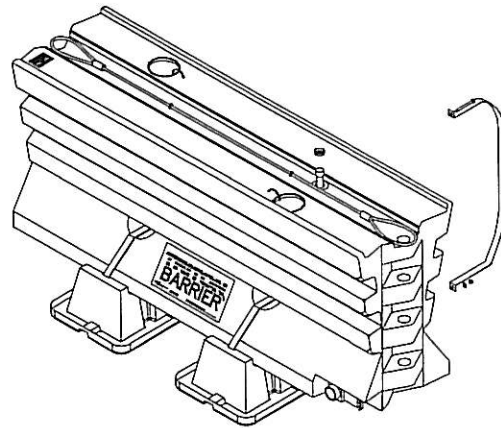


Figure 2
TRITON BARRIER TL-3 strap
(5 segments required)

2. Start by sliding or pinning the transition section onto the end of the CMB.
3. Begin deployment at the CMB to be shielded and work upstream. Work from the non-traffic side of the installation whenever possible. Unload the sections taking care not to damage them. Unloading proceeds much faster if one person remains on the truck and two people work on the ground.

TL-3 Configuration

4. Attach pedestals to the TRITON segments using a strap as shown in Figure 4 and Installation drawing. Five segments with pedestals are required.

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5. Prepare the first (inverted) TRITON Segment. Tighten interior U-bolt nuts fully (4 places - 2 each end). If plastic on inside of end knuckle begins to deform, stop. Add second nut (4 places - 2 each end). Tighten flush with first nut. Apply green Loctite #290 or equal to nuts after tightening (both ends). See figure 3.

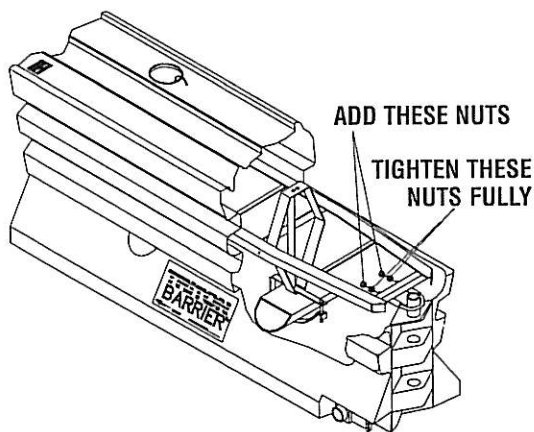


Figure 3
TRITON BARRIER TL-3 - First Segment
(1 segment required)

6. Using the pedestal as a template, drill $\varnothing 1/2"$ holes - 4 places as shown. Attach short pedestal to surface of first section using $3/8"$ nuts, lock washers, bolts and bar washers, as shown in figure 4 & View A-A. Use fill port as access hole.

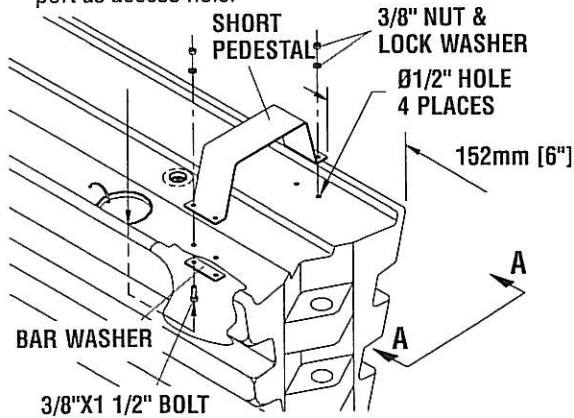
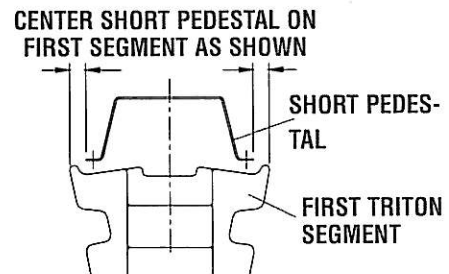


Figure 4
Cutaway View
(Shown right side up for clarity)

7. Using the lower set of knuckles, attach the rear-most TRITON section to the transition, see detail "A" on page 9. Insert a connecting pin through the top cable, through the top transition tab and into the overlapping end knuckles and transition tabs. Push the pin in until it is flush with the top of the section. Take care to orient the handle on the pin so that the handle is perpendicular to the length of the barrier. Slide the $1/4"$ x $3"$ x $4"$ bar washer over the end of the pin and secure with the $1/2"$ x $3"$ Hex Bolt and $1/2"$ Hex Nut (see detail "A" on page 9).
8. Bring the remaining four upright TRITON segments together and insert a connecting pin through the top cables and into the overlapping end knuckles at each joint. Push the pin in until it is flush with the top of the sections. Take care to orient the handle on the pin so that the handle is perpendicular to the length of the barrier. (See Figure 1 on page 4.)

WARNING!

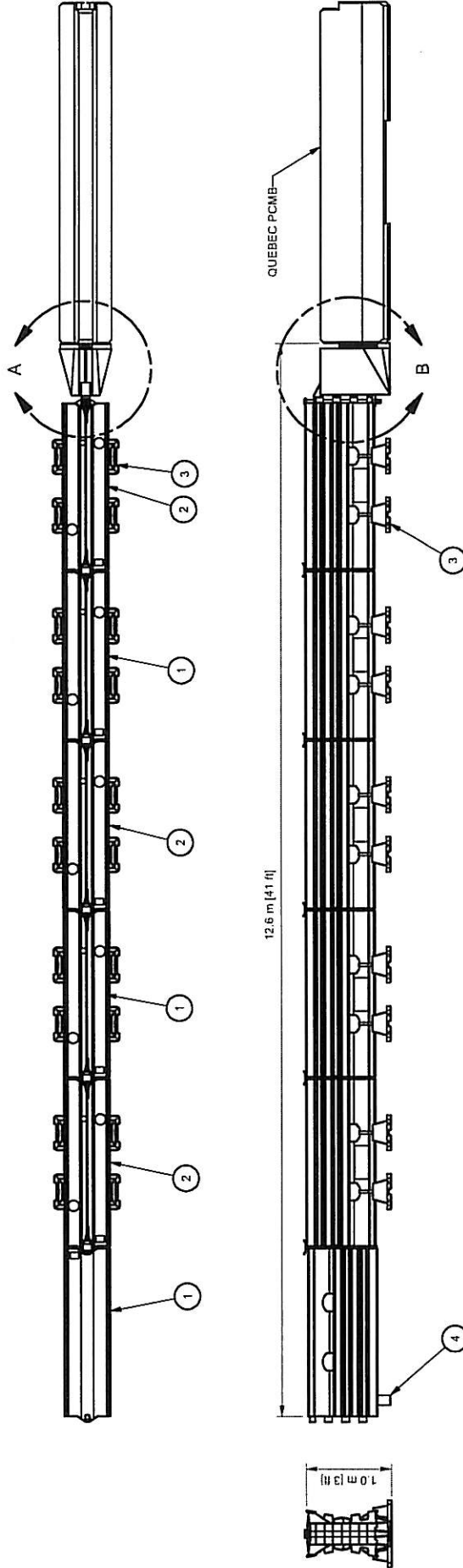
Each joint must be connected with a pin or improper impact performance will result. Barrier must not be used if steel cable is damaged or missing.



View A-A

PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	QTY.
1	3595020-0100	BARRIER SECTION ASSY, TRI, ORANGE	3
2	3595020-0000	BARRIER SECTION ASSY, TRI, WHITE	3
3	3595351-0000	TRITON TL-3 KIT	5
4	3595361-0000	END TREATMENT, TRITON, TL-3	1
5	2795400-0000	TRANSITION, TRITON, QBEC PCMB	1
6	2795401-0000	PIN, TRITON TRANSITION, G	1
7	2790313-0000	WASHER BAR, 1/4X3 1/2X4 G	1
8	2701361-0000	BOLT, HX, 1/2X3, G2 G	1
9	2704011-0000	NUT, HX, 1/2 G	1

THE DEPICTED TRITON CONCRETE END TERMINAL PLUS TRANSITION IS A NARROW, NON-REDIRECTIVE, GATING CRASH CUSHION. IT HAS BEEN CRASH TESTED FOLLOWING THE GUIDELINES IN NCHRP 350 TL-3 (100 km/h). ITS IMPACT PERFORMANCE IS SIMILAR TO A SAND-FILLED INERTIAL BARREL ARRAY. AS A CONSEQUENCE, CARE MUST BE USED IN ITS APPLICATION IN THE FIELD. IT IS RECOMMENDED THE TRITON CONCRETE END TERMINAL ONLY BE USED TO PROTECT PORTABLE (UNANCHORED) CONCRETE BARRIER AT SITES WHERE THE CHANCE OF HIGH ANGLE, HIGH SPEED IMPACTS IS LOW. WHEN THESE TYPES OF ANGLED IMPACTS MAY OCCUR, A REDIRECTIVE CRASH CUSHION, SUCH AS THE QUADGUARD SYSTEM, SHOULD BE INSTALLED INSTEAD.



ASSEMBLY NO. 3595400-0000

Revision	Rev	By	Chk.	App.
REVISED TO MATCH PEOPLESOFT	4/14/03	A	DK	JME
CHANGED ITEM 5 DESCRIPTION	4/14/03	B	DK	KM
				JBW

REFERENCES

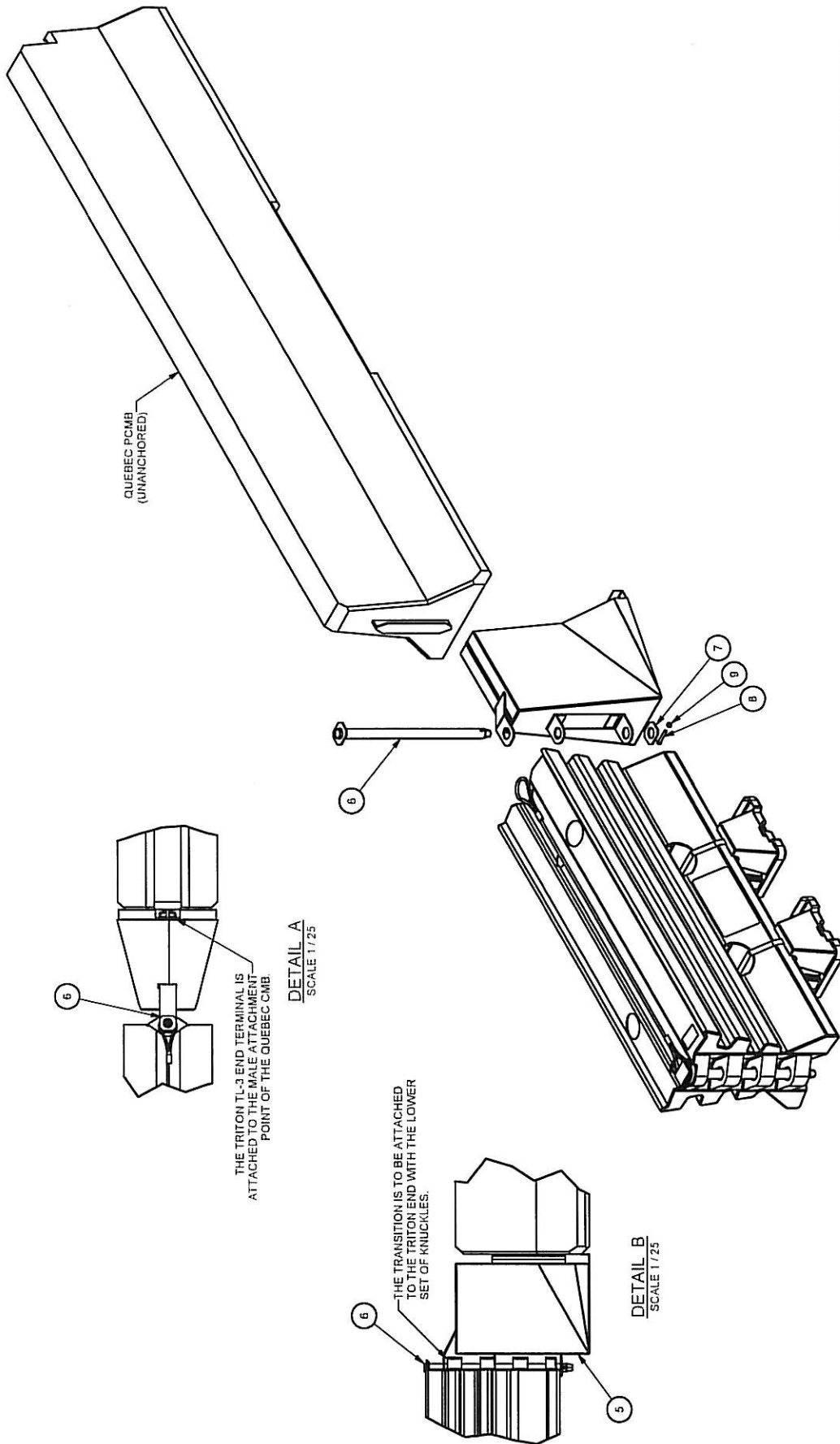
BARRIER SECTION ASSY, TRI
TRITON TL-3 KIT
END TREATMENT, TRITON, TL3

DESIGNED	D. Kohlfield	DATE	3/27/2003
DESIGNED	J. Welch	DATE	3/14/2003
CHECKED	JME	DATE	4/14/2003
APPROVED	JBW	DATE	4/14/2003
FILE	3595400-0000.dwg		

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

TRITON CONCRETE END TREATMENT (QUEBEC PCMB)

SCALE	1:50	SHEET	1	OF	2	REV	B
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ASSEMBLY NO. 3595400-0000

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

TRITON CONCRETE END TREATMENT (QUEBEC PCMB)

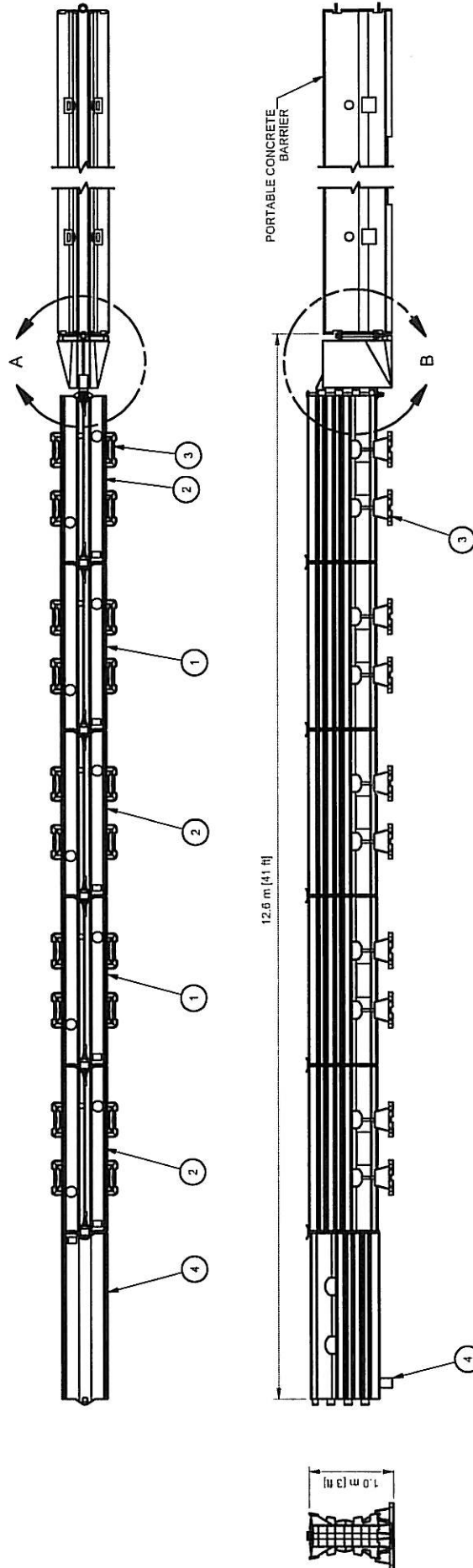
SCALE 1=50 SHEET 2 OF 2 REF B

DESIGNED	D. Kohnfeld	DATE	3/27/2003
DESIGNED	J. Welch	DATE	3/4/2003
CHECKED	JME	DATE	4/4/2003
APPROVED	JBW	DATE	4/4/2003
FILE	3595400-0000.dwg		
REV. 1/25/03			

Revision	Date	Rev	By	Chk	App.
REVISED TO MATCH PEOPLESOFT	4/4/03	A	DK	JME	JBW
SEE SHEET 1	4/14/03	B	DK	KM	JBW

PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	QTY.
1	3595020-0100	BARRIER SECTION ASSY, TRI, ORANGE	2
2	3595020-0000	BARRIER SECTION ASSY, TRI, WHITE	3
3	3595351-0000	TRITON TL-3 KIT	10
4	3595361-0000	END TREATMENT, TRITON, TL-3	1
5	2795403-0000	TRANSITION, TRITON PCMB	1
6	2795401-0000	PIN, TRITON TRANSITION, G	1
7	2798313-0000	WASHER BAR, 1/4X3 1/2X4, G	1
8	2701361-0000	BOLT, HX, 1/2X3, G2, G	1
9	2704011-0000	NUT, HX, 1/2, G	1
10	2701044-0000	BOLT, HX, 1 1/4X22, G	1
11	2715055-0000	WASHER BAR, 3/8X3 3/4X5, G	2
12	2708732-0000	WASHER, FLAT, 1 1/2 SAE, G	2
13	2704571-0000	NUT, HX, 1 1/4, G	1

THE DEPICTED TRITON CONCRETE END TERMINAL PLUS TRANSITION IS A NARROW, NON-REDIRECTIVE, GATING CRASH CUSHION. IT HAS BEEN CRASH TESTED FOLLOWING THE GUIDELINES IN NCHRP 350 TL-3 (100 km/h). ITS IMPACT PERFORMANCE IS SIMILAR TO A SAND-FILLED INERTIAL BARREL ARRAY. AS A CONSEQUENCE, CARE MUST BE USED IN ITS APPLICATION IN THE FIELD. IT IS RECOMMENDED THE TRITON CONCRETE END TERMINAL ONLY BE USED TO PROTECT PORTABLE (UNANCHORED) CONCRETE BARRIER AT SITES WHERE THE CHANCE OF HIGH ANGLE, HIGH SPEED IMPACTS IS LOW. WHEN THESE TYPES OF ANGLED IMPACTS MAY OCCUR, A REDIRECTIVE CRASH CUSHION, SUCH AS THE QUADGUARD SYSTEM, SHOULD BE INSTALLED INSTEAD.



ASSEMBLY NO. 3595500-0000



TRITON CONCRETE END TREATMENT
(PIN & LOOP PCMB)

1-50 3595500-0000 1 of 2

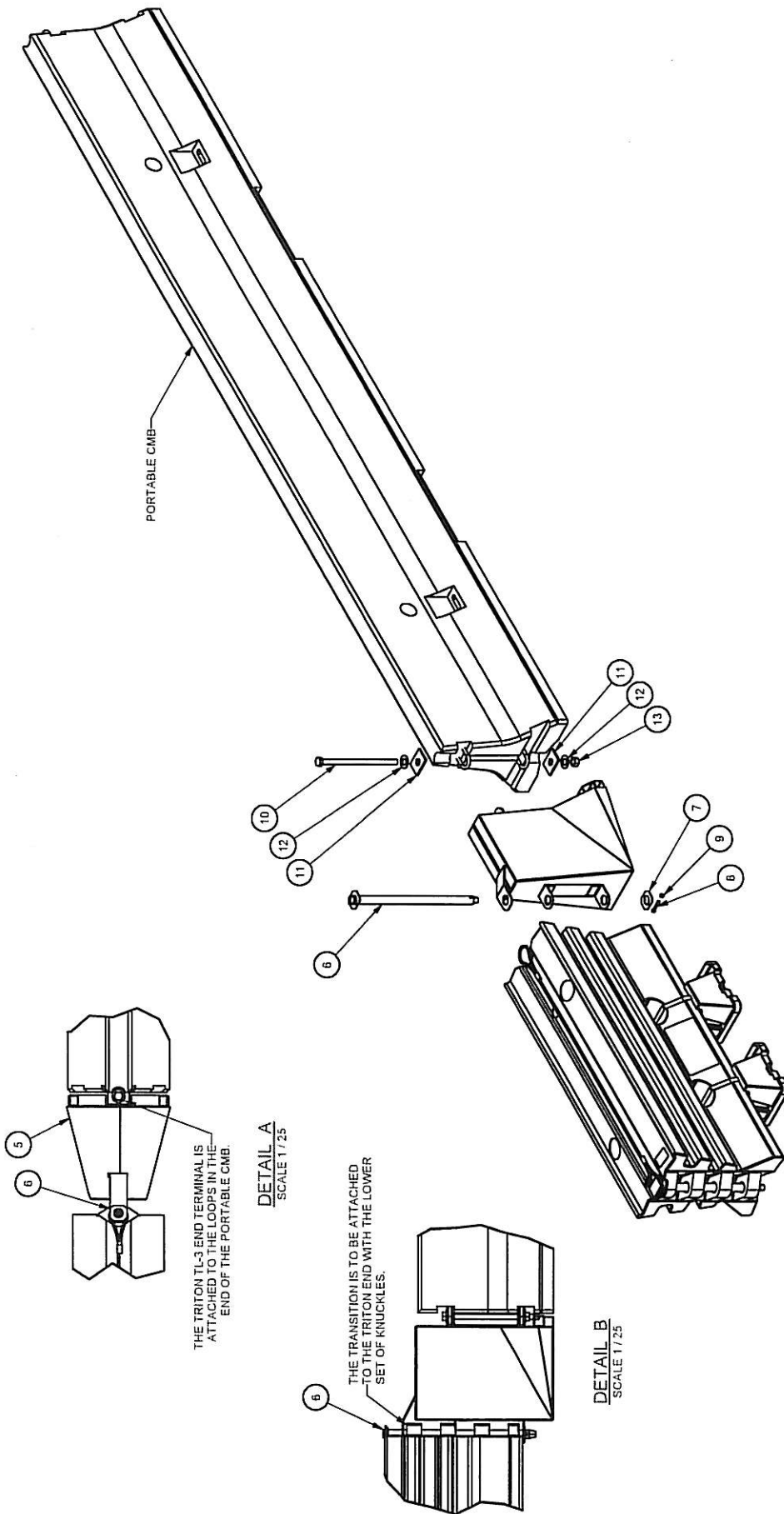
REFERENCES

BARRIER SECTION ASSY, TRI
TRITON TL-3 KIT
END TREATMENT, TRITON, TL3

3595020-0000
3595351-0000
3595361-0000

DATE	BY	CHKD	APP'D
4/11/2003	D. Kohfeld		
4/10/2003	J. Welch		
4/17/2003	KM		
4/17/2003	JBW		
FILE	3595500-0000 idw		

SCALE: AS SHOWN



ASSEMBLY NO. 3595500-0000

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

TRITON CONCRETE END TREATMENT

SCALE 1=25 DRAWING NO. 3595500-0000 SHEET 2 OF 2 REV.

DESIGNED BY	D. Kohfeld	DATE	4/11/2003
CHECKED BY	J. Welch	DATE	4/10/2003
APPROVED BY	KM	DATE	4/17/2003
DESIGNED BY	JBW	DATE	4/17/2003
FILE 3595500-0000.dwg			
REV. ASSEMBLY			

TRITON CONCRETE

Installation (cont'd.)

9. Bring the first barrier segment into place. For TL-3, be sure it is empty, turned upside down, and has a short pedestal attached (see figure 5). For TL-2, the first Triton barrier segment is empty but oriented right-side-up (see figure 5). Insert a connecting pin through the second TRITON segment top cable and into the overlapping end knuckles. **IMPORTANT! The pin must be removed from the exposed end.**
10. Remove the fill level indicator caps with a small flat screw driver (see Figure 1, page 4). Save the caps for reinsertion at the end of the job.

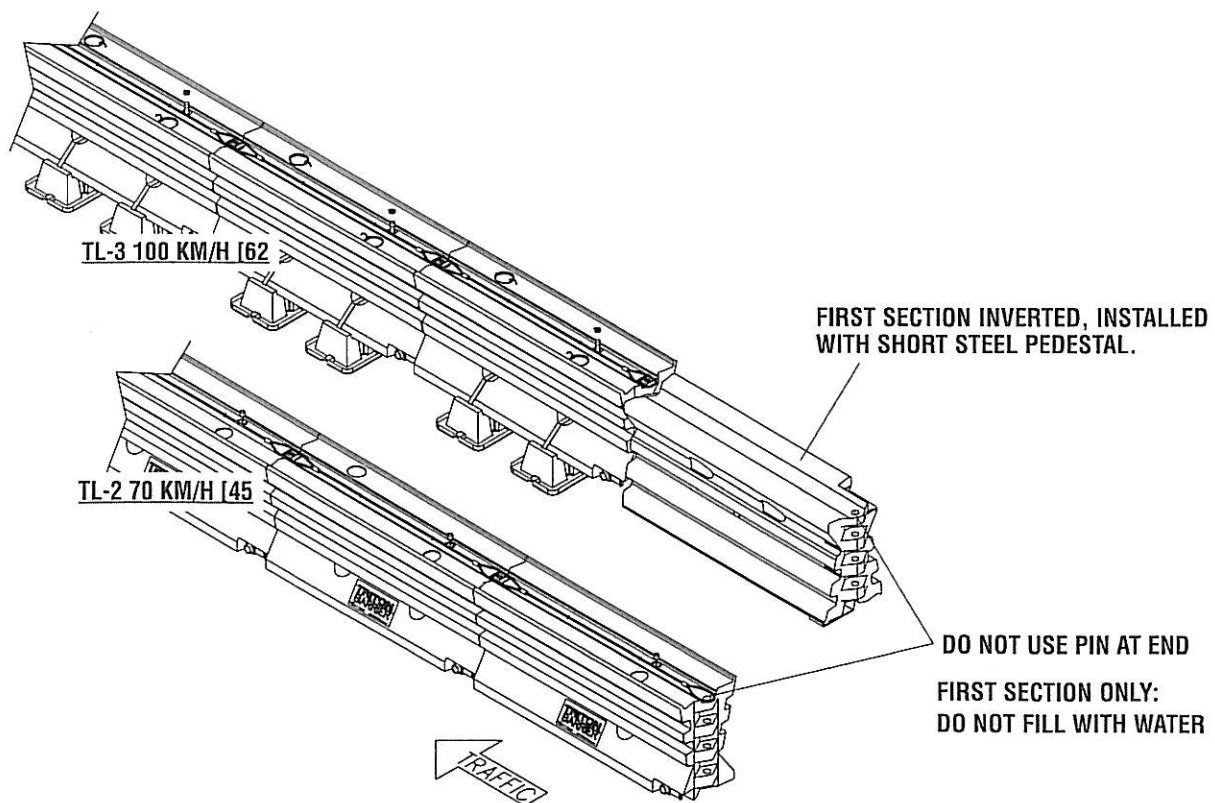


Figure 5
TRITON BARRIER end treatment

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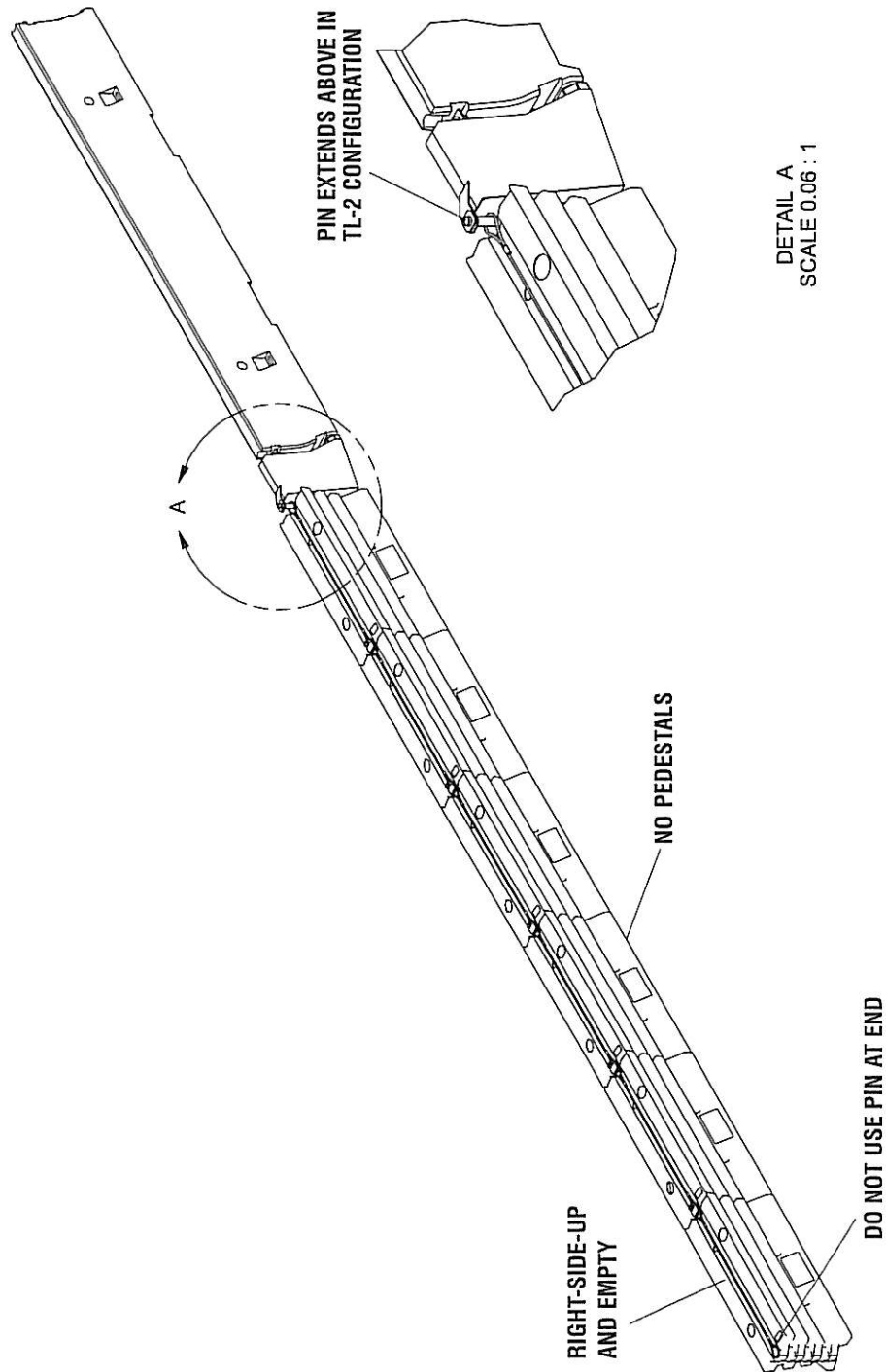


Figure 6
TRITON CET TL-2 Configuration

TRITON CONCRETE

Installation (cont'd.)

11. Completely fill the five upright segments with water. Approximately 2750 liters (725 gallons) will be required.

WARNING!

Sections must be filled with water to ensure proper crash performance.

It is imperative in colder climates that the water not freeze. In consideration of local restrictions or regulations, add antifreeze as necessary.

Since filling the sections typically takes longer than deployment, it is convenient to have a water truck available as soon as deployment begins. 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.

12. Place caps in fill holes to retard water evaporation and to prevent debris, bugs and birds from contaminating the water.
13. For TL-3 applications, the first barrier section must be turned upside down, empty and a short pedestal attached. For all applications, the pin must be removed from the exposed end.
14. Deployment is now complete. Take the time to double check the installation as shown below.

Checking the Installation

Check the installation to ensure that all sections are properly aligned, full of water ballast, and not leaking. All fill level indicators should be up. If any are not up, check to see if the caps used for shipment are still in place, and remove them. Make sure that all cables are present and all pins are inserted. If for some reason a section needs replacement, refer to the "Maintenance and Repair" section of this manual.

Retrieval

1. Begin retrieval at the nose end of the System. Begin the retrieval procedure by removing the water ballast. If site conditions permit, the quick release gate valve may be opened to allow the water to drain. Insert the protective fill level indicator caps.

Note: The time it takes to drain a barrier section is approximately 4.5 minutes.

CAUTION: Water on the traveled roadway may create a slippery surface for vehicles. Proper traffic control should be deployed.

If the water may not be drained at the site, then the water may either be siphoned out or the section can be unpinned and moved by forklift to another work area or a site where it may be drained or stored.

CAUTION:

Do not use tension cables to lift barrier. Use fork lift and lift ports.

2. Once the water is removed, the pins may be removed and the sections separated.
3. Reinstall fill indicator caps.
4. Remove the empty sections onto the transport truck in the reverse order as they were deployed. Secure the load before transport.

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Storing

When storing the Triton Barrier, be sure to leave the gate valve open or store upside down.

Note: Empty sections without pedestals may be stacked up to three high. Empty sections with pedestals attached may be stacked two high. Filled sections may not be stacked.

End Treatment

End treatment is defined by AASHTO Roadside Design Guide, 1989 as:

"The design modification of a roadside or median barrier at the end".

A terminal is defined by NCHRP 350 as:

"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."

The TRITON Concrete End Treatment System has been crash tested to NCHRP 350 TL-3 Non-Redirective Gating conditions. It has proven to be a crashworthy end treatment for 100 km/h [62 m.p.h.] impact speeds when installed as shown.

TRITON CONCRETE

Maintenance and Repair

To Remove Pin

1. Pry pin up while pushing cable loops down.
2. Once pin is up approximately 100 to 125 mm [4" to 5"], the pin can be twisted to remove.

Proper maintenance of TRITON Concrete End Treatment System is essential to assure maximum performance. Take the 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.

Visual Drive-By Inspection

A slow drive-by visual inspection of TRITON Concrete End Treatment System is often all that is required. Some special inspection considerations are:

1. For TL-3 applications, the first barrier must be turned upside down, empty and strapped to the short pedestal. For all applications, the pin must be removed from the exposed end.
2. Are the five other sections full of water ballast? The sections must be adequately filled for proper impact performance. Look to see that the fill level indicators are visible above the top of each section. A walk-up inspection of the installation is required if the fill indicators are not visible (see Walk-Up Inspection section). Be sure fill indicator caps used for shipping have been removed.
3. Are the sections properly aligned? The installation must be aligned according to the plans for the site. Misaligned sections in the middle of an installation may be an indication that the barrier has been hit and potentially damaged. If any sections are misaligned,

carry out a walk-up inspection.

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:

Empty Sections

Sections with water levels below 100 mm [4"] from the top must be refilled for proper TRITON Concrete End Treatment System performance. Sections with very low water levels, or those that consistently need filling, should be filled and thoroughly inspected for leaks. If leaks are found, the section should be replaced (see Damaged Sections below). A certain amount of water loss may occur due to evaporation depending on the environment. Note: The first barrier section must be empty. (See number 1 above.)

Damaged Sections

Generally sections are usable if they remain full of water and properly connected to other sections. Occasionally, sections may become damaged from impact or puncture and must be replaced. Sections with minor damage or leaks may often be repaired using sealants or plastic welding methods. (See TRITON BARRIER Patching.) Empty the water from the sections immediately surrounding the damaged section(s). Remove the pins holding the damaged section(s) and slide the section(s) sideways until enough gap opens up in the installation for removal. New sections are replaced by reversing this process. Take care to work in a direction away from traffic and to prop-

END TREATMENT™

erly line up the installation when replacement is complete (see Misaligned Sections).

Misaligned Sections

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

TRITON BARRIER Patching Preparation:

The area to be patched must be completely dry and free of dirt and grease. Additionally, a film coats the barrier 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.

Options:

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 deg. C [550 deg. F.] for the Triton material. Welding speed for ideal, straight line welds can range from 100 mm - 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 TRITON BARRIERS. Individuals who will be performing the repairs should read the instructions and practice a few times before trying to repair TRI-

TON BARRIER. 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 repair:

- Drill Motor w/7 mm drill bit
- 25,000 rpm Router
- Spin Weld tool
- Spin Weld plugs
- Rasp

1. Drill 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, holding it steady until the plastic solidifies.
6. Inspect plug to insure that it has bonded to the barrier.
7. Rasp plugged area smooth to finish repair.

Hot Glue Gun

Relatively good success in patching the TRITON BARRIER® 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, etc. 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 barrier. Duct tape

TRITON CONCRETE

Maintenance and Repair (cont'd.)

(silver, fiber reinforced tape) sticks to the barrier well, and Butyl caulking (gray, sticky pads or rolls) works fairly well to fill gaps for temporary patching.

The black and white TRITON BARRIER decals stick well to the barriers. 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.

Both 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/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 barrier may be refilled with water.

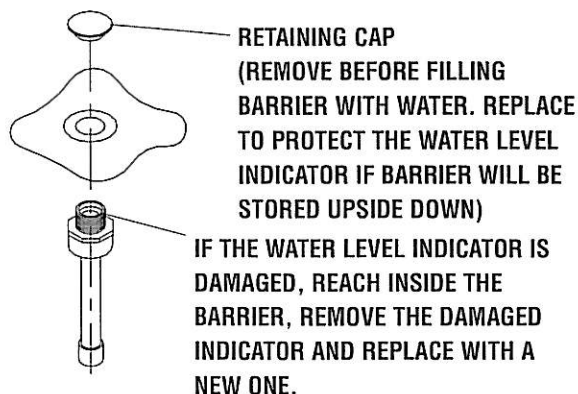


Figure 7
Water level indicator

Any repaired barriers 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 they can be unscrewed. Six or seven wraps of Teflon tape will keep the threads from leaking.

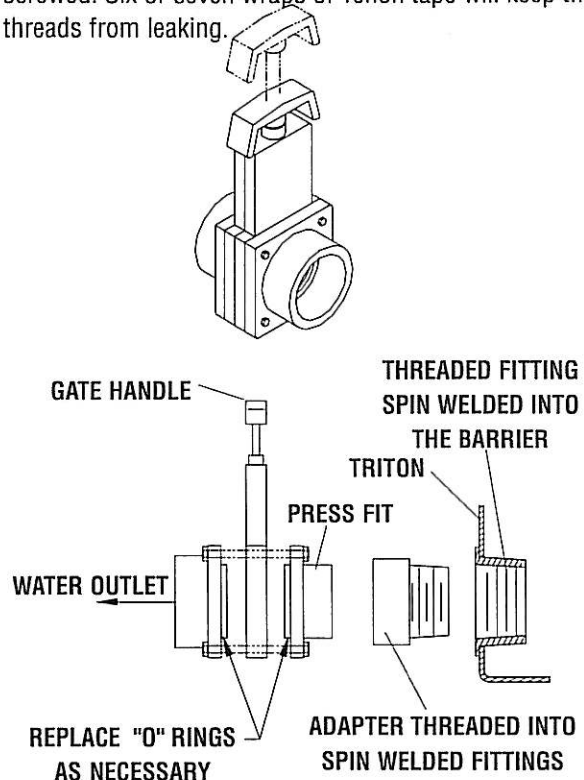


Figure 8
Repair of the gate valve

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Glossary

Appurtenance-Apparatus or equipment related to vehicular transportation. (E)

Barricade-A device that provides a visual indicator of a hazardous location or the desired path a motorist should take. It is not intended to contain or redirect an errant vehicle. (A)

Barrier-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. (A)

Bidirectional-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. (E)

Capacity-The ability of an appurtenance to absorb the kinetic energy of an impacting vehicle in a safe and controlled manner. (E)

Channelizing Device-A device used to warn and alert drivers of hazards created by work activities in or near the traveled way and to guide and direct drivers safely past the hazards. It is not intended to contain or redirect an errant vehicle. (T)

Clearance-Lateral distance from edge of traveled way to a roadside object or feature. (A)

Clear Zone-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 nonrecoverable slope, and/or a clear run-out area. The desired width is dependent upon the traffic volumes and speeds, and on the roadside geometry. (A/N)

Construction Zone-A highway area under construction or refurbishment with traffic concerns. (E)

Crash Tests-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. (A)

Crashworthy-A feature that has been proven acceptable for use under specified conditions either through crash testing or in-service performance. (A)

Critical Impact Point (CIP) - That point along a device with the greatest potential for snagging or pocketing an impacting vehicle. (E)

Design Speed-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. (A)

End Treatment-The designed modification of a roadside or median barrier at the end. (A)

Flare-The variable offset distance of a barrier to move it further from the traveled way. (A)

Gating Device (Feature) - 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. (N)

Gawk Screen-A device used to shield selected roadside areas from a driver's vision. (E)

Glare Screen-A device used to shield a driver's eye from the headlights of an oncoming vehicle. (A)

Hazard-Something dangerous and obstructive in the median, roadway, or roadside. (E)

Impact Angle-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. (A)

Lateral Deflection-The distance an appurtenance is deflected sideways from its original position. (E)

Length of Need (LON) - Total length of a longitudinal barrier needed to shield an area of concern. (A)

Longitudinal Barrier-A barrier whose primary function is to prevent penetration and to safely redirect an errant vehicle away from a roadside or median hazard. (A)

Median-The portion of a divided highway separating the traveled ways for traffic in opposite directions. (A)

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Glossary (cont'd.)

Median Barrier - A longitudinal barrier used to prevent an errant vehicle from crossing the highway median. (A)

Non-Gating Device - 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)

Offset - The distance between the traveled way and a roadside barrier or other obstacle. (A)

Penetration - Action of a vehicle passing into or through an appurtenance by overcoming its redirective resistance. (E)

Performance Level - The degree to which a longitudinal barrier is designed for containment and redirection of different types of vehicles and speeds. (A)

Redirective - A characteristic of an appurtenance that indicates that the device smoothly controls a vehicle angle impact without pocketing or penetration. (E)

Roadside - That area between the outside shoulder edge and the right-of-way limits. (A)

Roadside Barrier - A longitudinal barrier used to shield roadside obstacles or non-traversable terrain features. It may occasionally be used to protect pedestrians or "bystanders" from vehicle traffic. (A)

Roadway - The portion of a highway, including shoulders, for vehicular use. (A)

Secondary Impact - Vehicle impact(s) subsequent to vehicle loss of contact with an appurtenance. (E)

Shielding - 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)

Slope - 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)

Temporary Barrier - A device used to prevent vehicular ac-

cess 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)

Test Level - A set of impact conditions, defined in terms of vehicular type, mass, speed, and angle, that quantifies the performance level of a traffic barrier. (N)

Traffic Barrier - 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)

Transition - That part of a longitudinal barrier between and connecting sections of differing lateral stiffness. (N)

Traveled Way - That portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes. (A)

Underriding - Abrupt movement of an impacting vehicle down and underneath an appurtenance. (E)

Vaulting - Abrupt movement of an impacting vehicle up and over an appurtenance. (E)

Vehicle - As used herein an automobile used in transporting passengers ranging in weight and styles from 820 to 2000 kg [1800 to 4415 lb.]. (E)

Warrants - The criteria by which the need for a safety treatment or improvement can be determined. (A)

References:

- (A) American Association of State Highway and Transportation Officials. "1989 Roadside Design Guide" Washington D.C.).
- (E) Energy Absorption Systems, Inc., "Safety Needs Analysis Program (SNAP)" Chicago, IL: Energy 1992.
- (N) National Cooperative Highway Research Program Report 350 (NCHRP 350).
- (T) Lewis, R. M., "Work Zone Traffic Control Concepts and Terminology," *Transportation Research Record*, No. 1230, Transportation Research Board, 1989, pp. 1-11.

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Limitations and Warnings

The TRITON Concrete End Treatment System has been successfully tested and evaluated per the NCHRP 350 guidelines (NCHRP 350) for 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 TRITON Concrete End Treatment System (see Deployment and Retrieval section of this manual) is capable of dissipating the kinetic energy of errant vehicles:

Vehicles:

Small car, large sedan and pickup

Speed:

TL-3 100 km/h [62 m.p.h.]

TL-2 70 km/h [45 m.p.h.]

Mass:

820 and 2000 kg

[1808 and 4409 lb]

Angle:

The TRITON Concrete End Treatment System is a non-redirective crash cushion. It is recommended that the TRITON Concrete End Treatment System only be used to protect portable (non-anchored) concrete barrier at sites where the chance of high angle, high speed impacts is low. When 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 TRITON Concrete End Treatment System is essential to assure maximum performance (see the Maintenance and Repair section of this manual).

TRITON CONCRETE

Notes

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Notes

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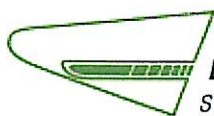
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